IMPACT OF EMPLOYEE PSYCHOLOGICAL EMPOWERMENT, PROCESS AND EQUIPMENT ON OPERATIONAL SERVICE QUALITY IN THE OILFIELD SERVICE INDUSTRY

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ABSTRACT

This study examines the impact of employee psychological empowerment, process and equipment maintenance on operational service quality in the oilfield service industry. With services ranging from exploration to downstream activities including supply of personnel, and products such as crude oil, natural gas and refined products, the oilfield operations presents unique operational quality challenges. Measured mostly in terms of non-productive time, the success and failure of operations have necessitated a focus on personnel, equipment maintenance and process by researchers. However, with diminishing reserves, fluctuating product demand and stringent laws and regulations, organizations seek to optimize resources and strategically invest on the factor(s) with significant potential to reduce non-productive time, and subsequently improve quality and efficiency. This study therefore, adopting a mixed method approach, aims to determine which factor(s) are significantly associated with quality to aid this strategic focus and investment.

Data from interviews and questionnaires from oilfield operations personnel along with the extensive literature review provided the industry-specific relevant associations. The analyzed empirical results from 151 respondents, using structural equation modeling, showed employee psychological empowerment (p-value 0.032) and equipment maintenance (p-value 0.050) as significantly associated to operational service quality much more than process (p-value 0.106). Further analysis also showed choice, impact, competence and meaningfulness as having significantly high association to psychological empowerment. Based on these results, three oilfield case companies were employed to validate the resulting revised framework. The result of improved quality showed a framework that demonstrated high utility in practice.

PUBLICATIONS

Journal Paper Publication

1. Onyemeh, N., Lee, C.W and Abakr, Y., (2014), 'Employee Empowerment Research - Current Status and Future Trend': A 26-year Snapshot of Empowerment Literature (1987 – 2013), Global Perspective on Engineering Management, Vol. 3 (3); pp. 46-56.

Conference Proceedings

1. Onyemeh, N and Lee, C.W (2014), "Improving Quality of Operations Via Industry-Specific Empowerment Antecedents: A Study of the Oil and Gas Industry." Paper presented at the 2014 International Conference on Industrial Engineering and Engineering Management (IEEM), 9 – 12 December 2014, Kuala Lumpur, Malaysia.

2. Onyemeh, N., Lee, C.W and Gunasekaran, S. (2015), Psychological Empowerment as a Strategy for Personnel Retention in the Oilfield Service Industry. Paper presented at the 2015 International Conference on Industrial Engineering and Engineering Management (IEEM), 6 – 9 December 2015, Singapore.

3. Onyemeh, N., Lee, C.W and Igbal, M. (2015), Key Performance Indicators for Operational Quality in the Oil and Gas Industry: A case Study Approach. Paper presented at the 2015 International Conference on Industrial Engineering and Engineering Management (IEEM), 6 – 9 December 2015, Singapore.

4. Onyemeh, N., Lee, C.W and Cheng, K. (2015), "Comparing Psychological Empowerment Levels of Field Employees in Small and Large Companies of the Oilfield Service Industry." Paper presented at the 2015 International Conference on Industrial Engineering and Engineering Management (IEEM), 6 – 9 December 2015, Singapore.

Poster Presentation

1. Onyemeh, N., Lee, C.W., and Spowage, A., (2013), 'Operational Service Quality Management via Industry-Specific Antecedents of Empowerment: A study of the Oil and Gas Industry'. Poster presented at the University of Nottingham Faculty of Engineering Post Graduate Research Poster Presentation and Competition 2013, Selangor Malaysia on 1st Oct 2013.

Contributions/Activities

1. Reviewer for the IEEM International Conference on Industrial Engineering and Engineering Management (IEEM) 2015.

2. Facilitator Poster Presentation at University of Nottingham, Malaysia Campus poster presentation 2013.

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"Feeling gratitude and not expressing it is like wrapping a present and not giving it."

-William Arthur Ward (1921-1944),

American author and speaker

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DEDICATION

My three sons and my very dear husband bore the brunt of the long hours of my absence; long hours created by the time I needed to research and write. My two elder sons did the not-too-enviable job of babysitting their toddler brother. My husband became father-mother, all in one. You all – my family - are my greatest cheerleaders and support! The joy and pride of actualizing this dream is yours as well as mine. I dedicate this study to you!

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CHAPTER 1 INTRODUCTION

> An introduction is like a map that enables you navigate your way in unfamiliar environment.

1.0. Aim

The aim of this chapter is to present the background and context of this onerous study, while highlighting the main objectives and the contributions of the endeavour. Furthermore, it shows the research framework used in limiting the scope of the relevant data gathered and presents the developed hypothesis. A snapshot of the research activities and the arrangement of all the chapters that all together set the achievement of this study are also given in this chapter.

1.1. Research Background

The expression 'getting it right the first time' is a quest, which the oilfield service industry has pursued and promoted with many unique quality improvement initiatives. Three reasons for this quest, according to Mitchell et al. (2012), include:

i. Vast increase in scale and technical complexity of projects which has impacted scale of project financing
ii. Competitive investor attraction, and
iii. The unforgiving operating environment, which altogether poses a great risk to humans, and the environment.

However, as evidenced by operational failures such as the Macondo oil spill incident in 2010, achieving this quest to get it right the first time (which is at the heart of a quality culture) has proven to be a serious challenge. The oil spill incident and the non-productive time that followed (a combined result of personnel, process and equipment failure) left eleven people dead, a $10 billion financial loss to British Petroleum (BP), an inestimable damage to the United States environment and thousands of dollars paid as compensation (BP-Website, 2013) with consequences that have adversely affected the reputation of the industry.

Operational quality failures in the oilfield service industry can result due to a number of reasons including personnel, process and equipment failures. These failures, which often times lead to non-productive time (NPT) ranging from 20% to about 30% (Nicholson et al., 2010) constitute a significant financial loss to the companies. According to Athens Group (2010), the financial loss resulting from operational quality failures, (for example, in drilling) could be as high as US $100-$150 million plus per year. Citing a few examples given by Athens Group (2010), personnel failure due to inexperience cost $1M downtime in an operation, personnel failure due to incorrect implementation cost $6million dollars financial loss and equipment failure due to maintenance resulted in $3.2M financial loss.

Operational failures, with its resulting financial loss, are particularly of concern since the oilfield service companies get paid for services rendered based on operating time (OPT). Operating time (for rig-operated operations) is defined as the time in hours spent occupying or otherwise using the well in order to perform a job or a series of jobs. This must be equal to the time elapsed from rig-up to rig-down for any operation, including time spent redoing jobs (non-productive time) due to failures, and running in and out of well. Non-productive time is considered part of operating time. For non rig-related operations, operating time is the number of hours spent completing jobs including time spent redoing jobs due to non-conformance.

According to Cox and Corrigan (2014) the two main causes of client non-productive time are product reliability and process reliability, with each accounting for one quarter and three quarters of the entire causes respectively. Whereas product reliability involves maintenance practices, process reliability is people-oriented, including such things as competency and procedural adherence (Figure 1.0).

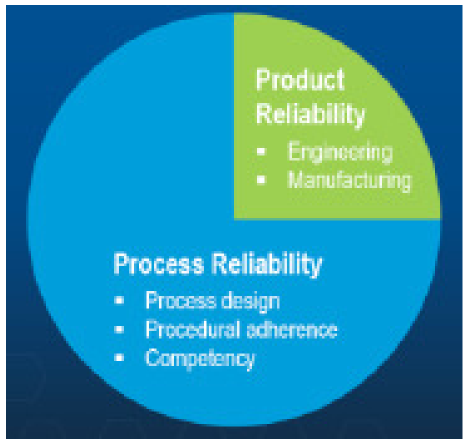


Figure 1.0: Principal causes of customer non-productive time
Source:Cox and Corrigan (2014)

Key challenges, according to Cox and Corrigan (2014), include developing systematic and repeatable processes, influx of inexperience in the industry, elimination of short cuts in operations and changing the conversation from delivering safe operations to delivering perfect operations.

Furthermore, owing to cost associated with capital projects, the amount which Kaiser (2009) suggests could be as much as $12M in the case of drilling a single offshore well, oil and gas companies are focusing on strategies to reduce non-productive time, increase production from existing reserve, and control maintenance costs (Nicholson et al., 2010). According to Nicholson et al., 2010, non-productive time for exploration and production assets is often in the 20% - 30% range.

The oilfield service industry provides an important case study for a number of reasons, four of which are highlighted below.

1. All over the world, the industry has garnered a reputation as a high-risk industry due to the nature of its activities and the challenging work condition (Mearns and Yule, 2009). This high risk factor suggests a zero tolerance culture to non-conformance in all areas of operation. With oilfield services ranging from exploration to downstream activities, including supply of service personnel, it is important for the employees to represent their organization effectively and responsibly in front of the client.

2. Due to high cost and long gestation periods for oilfield development projects, oilfield service firms have a duty to provide their clients with the delivery assurance that eliminates rework; meets project objectives and legal obligations. All these are achieved utilizing the latest technological advances in equipment, skilled personnel and effective processes. In other words, the client has a right to expect quality service and the oilfield service organizations have a responsibility to give quality and excellent service.

3. The industry's vision towards unmanned facilities as showcased in the 2013 Offshore Technology Conference (OTC) in Houston, proposes a radical redesign of future offshore facilities especially in remote areas to highlight minimal normal operating presence (MNOP) or zero normal operating presence (ZNOP). This implies that its operations which rely heavily on excellent automated control will be monitored off-site from a control room, with fault diagnostics and network capabilities that deliver operational success (Nory, 2012). Hence, proper maintenance cycle for all control and operational loops becomes imperative.

4. Unlike the oil industry, some industries like manufacturing, public utilities, construction and hospitality industry have been the focus of quality improvement studies (Lai and Cheng, 2003).

1.2. The Research Problem and Objectives

Personnel, process and equipment are considered the three major factors affecting the success or failure of projects (Heiser and Render, 1999) and have formed the basis of continued focus across the oil field industry (Mooney and Smith, 2012, Clark et al., 2015). Related research works on improving operational service quality have also shown this focus giving credence to the challenge it poses for organizations (Brown, 2013, Palmberg and Garvare, 2006, Zairi, 2002).

According to Deming (1986), companies desiring to get rid of their failures should focus on correcting their processes first. Clark (2013), on the other hand, in analyzing oilfield drilling activity states that addressing equipment failure will likely have the most significant impact on operational quality with a subsequent reduction in non-productive time. Furthermore, according to Hoover (2000), the main cause of incidents in the Gulf of Mexico, which represents the heart of the oil business, is due to human and equipment citing 42% of incidents due to equipment failure and 41% due to human error in year 2000. However, Covey (2014) maintains that what is required is an inside-out approach with a focus on the person first - their paradigms and motives. According to Covey (2014), people are the programmers, the true differentiators, using systems and structures as outward expressions of character and competence supporting Reason (1995) statement that human rather than technical failures now represent the greatest threat to complex and potentially hazardous systems. Psychological empowerment related causes exhibited in areas such as knowledge-skill-ability errors, task omissions and risk taking according to Baker and McCafferty (2005) contribute 80 to 85% of the accidents in the industry. According to Bowen and Lawler (1992), empowered employees with an understanding of the importance of a quality organization will typically deliver quality operations.

Ten post-incident remarks on some past incidents in the industry stated below support this viewpoint.

Incident #1– Petrobas FPSO Explosion (2015)

"The main causal factors identified were breaches of fluid pumping operating procedures, the installation of a piece of equipment (racket) in a pipe without the proper technical specifications and alteration registration, and safety procedure violations." (*Offshore Energy Today, 2015)*

Incident #2– Stena Clyde Fatality Incident (2012)

"Investigation identified that senior management on the Stena Clyde failed to apply the management of change principles in failing to carry out a new risk assessment and toolbox talk after altering the original plan of works.

(*NOPSEMA, 2015*)

Incident #3– BP Deep-Water Horizon Spill (2010)

"Possibly the worst and most controversial environmental disaster in U.S. history resulting from a combination of employee decision and equipment failures"

(British Petroleum Macondo Investigation Team, 2010)

Incident #4– Methane in Drinking Wells (2009)

''Resulting from too much pressure in the mile-deep wells, or flaws in the cementing and steel casings, causing pollution of drinking water'' *(Legere, 2009*)

Incident #5– Bourbon Dolphin Capsize (2007)

"No chain is stronger than its weakest link. Where human beings are involved, experience shows that mistakes are made." *(NOU official Norwegian Report, 2008*)

Incident #6– Corroded BP Pipeline Spill (2006)

The undetected leak of 267,000 gallons of thick crude oil over two acres near the Prudhoe Bay production area was part of a widespread neglected corrosion problem in its system.

(*Barringer*, 2006)

Incident #7– Texas City Refinery Explosion (2005)

"The panel found a lack of operating discipline, tolerance of serious deviations from safe operating practices, and apparent complacency toward serious process safety risks."

-*(BP U.S. Refineries Safety Review Panel Report, 2007, p. 60*).

Incident #8 – Pipeline Ruptures Causing Large Oil Spill (2000)

"Pipeline owned by Marathon-Ashland, ruptured near Winchester, Kentucky, spilling nearly 500,000 gallons of crude oil. Although this was due to fatigue cracking in the line, contributing to the severity of the accident was the failure of the controller and supervisors to recognize and isolate the rupture, as well as shutdown the pipeline in a timely manner.

(U.S National Transportation Safety Board, 2000)

Incident #9– Longford Gas Plant Explosion (1998)

"A combination of ineffective management procedures, staffing oversights, communication problems, inadequate hazard assessment and training shortfalls combined to result in a major plant upset with consequential tragic loss of life."

-*(Nichol, 2001, p. 9)*

Incident #10– Piper Alpha Disaster (1988)

"It was caused by a massive fire, which was not the result of an unpredictable 'act of God' but of an accumulation of errors and questionable decisions. Most of them were rooted in the organization, its structure, procedures, and culture."

(Paté-Cornell, 1993, p. 215).

According to Scharmer (2010), the relational and transformational capacity building that not only touch individuals but also engage and empower the entire system is the real bottleneck in all deeper systemic change efforts to improve service quality. This varied opinion on the greatest threat to operational quality is a dilemma for organizations in implementing initiatives to address non-productive time. Appreciation of the foregoing forms the premise for determining the impact of personnel, process and equipment on operational service quality to enable improvement efforts.

Furthermore, employee empowerment has long been identified as a great enabler for quality improvement, being seen as a way to obtain employee involvement (Fok et al., 2000) and as a non-monetary motivation strategy (Al-Harthy, 2008). However, according to Dainty et al. (2002), empowerment can really only be said to have occurred if the individual believes that they have been empowered. This implies that the individual cannot be said to have been empowered without feeling that he is. A study by Thomas and Velthouse (1990) identified choice, competence, impact and meaningfulness as antecedents of employee psychological empowerment, while other research endeavours have indicated the need for accountability (Williard and Hitchcock, 2013), responsibility (Baird and Wang, 2010) and mindfulness (Ndubisi, 2012) as empowerment elements that enable quality improvement.

There is a need therefore to ascertain which of the empowerment antecedents, if not all, are of stronger significance in the oilfield industry thereby offering significant potential to improving operational quality. According to Alireza et al. (2011), if it is considered that millions of dollars should be spent for drilling a well, one can find importance of even 1% reduction in non-productive time (p.25).

In recognition of the dynamics and realities of the business world, and with a view to enable a more focused attention in the improvement of operational service quality, this study therefore has specific research objectives (RO) as follows:

RO1. To determine the significance of employee psychological empowerment, process and equipment on operational service quality in oilfield service industry

RO2. To determine the significant antecedents of employee psychological empowerment in oilfield service industry

RO3. To validate the theoretical framework for improving operational service quality in oilfield service industry

These will enable us answer two research questions, namely:

1. What is the importance of employee psychological empowerment, process and equipment maintenance on operational service quality in the oilfield service industry?
2. What antecedents of employee psychological empowerment are strongly relevant in the oilfield service industry?

1.3. Research Method and Procedure

The research method adopted in this study is the mixed study approach. Two techniques are used to gather data from respondents in the oilfield service industry: semi-structured interview and questionnaire survey. The interview data gathered is manually transcribed, categorized, and crosschecked with literature and other evidence sources, using the triangulation process. The result of the questionnaire survey, carried out in stages of pre-, pilot and field test, is analysed to yield a practical framework. The practicality of the final model is demonstrated with the use of three case study companies enriching the findings from the analysis.

1.4. Research Contribution and Importance

The contribution of achieving RO1 is knowledge-based as well as practical. Prior to this study, each of the three critical success factors had received significant independent research with no significant effort on conducting an integrated research. By establishing a relationship between the three critical operational factors in the industry, this study contributes to the body of knowledge on practice of quality management in the oilfield service environment.

Practically, the established linkage will enable quality-pursuing companies to better align their efforts to suit the target or goals of their companies and achieve desired result. Furthermore, with the importance of the petroleum industry to the global economy, any improvement in operational quality will have a significant effect on the regional, national and global economy.

The contribution of achieving RO2 is the provision of a practical employee psychological-empowerment framework that is expected to demonstrate high utility in practice and significantly contribute to the reduced operational service failure rates in the industry. The employee psychological empowerment antecedents that are found to be statistically significant will enable targeted investment and potential benefits in a short span, inevitably enabling organizations to optimize the pool of talents. Optimizing the pool of talents is critical in the oilfield service industry in that it enables organizations to align their revenue-generating population with revenue-generating activities to capture planned growth and increase profitability.

This study also fills the gap of a much-needed oilfield service industry-specific investigation of employee psychological empowerment in relation to quality practice. This is particularly so since there have been various studies on employee empowerment in various service organizations such as education (Ghani et al., 2009), IT (Raquib et al., 2010), hotel (Ayup and Chung, 2010), MNCs (Azman et al., 2009) unlike in the oilfield services industry. Industry specific studies, advocated by researchers such as Sila and Ebrahimpour (2003), provides the raw material for fleshing out and further refinement of concepts (Garvin, 1988), better understanding of organizational performance, and helps appreciate true applicability of relevant theories (Bamberger, 2008).

1.5. Thesis Arrangement

The outline of this study has been arranged as explained below.

Chapter 1

Provides the background of the research problem and sets the stage for this thesis. It enables the reader to understand the study and appreciate the rationale for its undertaking by outlining the research objectives and contribution. The outline of the thesis is also shown in this chapter.

Chapter 2

This chapter reviews the literary works of other authors on the conceptual components of this study in a five-part division. It defines and outlines the role each plays in operational quality setting together with its critics and identified gaps. By leveraging this literature, the antecedents of psychological empowerment were isolated for examination of significance in the industry.

Chapter 3

This chapter outlines the different research methods recognized in literature and, more importantly, highlights the justification for the choice of methodology, data collection and analysis adopted for this study while presenting the elements of measurement. It also elaborates the tools employed in answering the research questions as well as presents the rigour involved in the entire process.

Chapter 4

This chapter highlights the result and findings from the semi-structured interview and the quantitative survey that followed. Divided into two distinct models of A and B respectively, the result of the quantitative survey was analyzed with findings further corroborated with three case study companies.

Chapter 5

This chapter concludes by restating the purpose of the research and the key findings from the result obtained and data analyses performed. The challenges faced in the course of the study, as well as possible direction for future research is also presented.

1.6. Chapter Summary

This chapter provided the overview of the research background, the research problem, the objectives and contribution of this work. The subsection on research problem provided answers to the following questions

- What is the problem?
- Why is it a problem?
- Where is it a problem?
- How is and/or how big is the problem?
- When is it a problem?
- To who is it a problem?

The framework and hypothesis developed in this chapter form the basis for the rest of the research process, enabling us to focus on the scope of study and establish the relationships between the factors outlined. The structure of the entire thesis is also depicted in Figure 1.1 below.

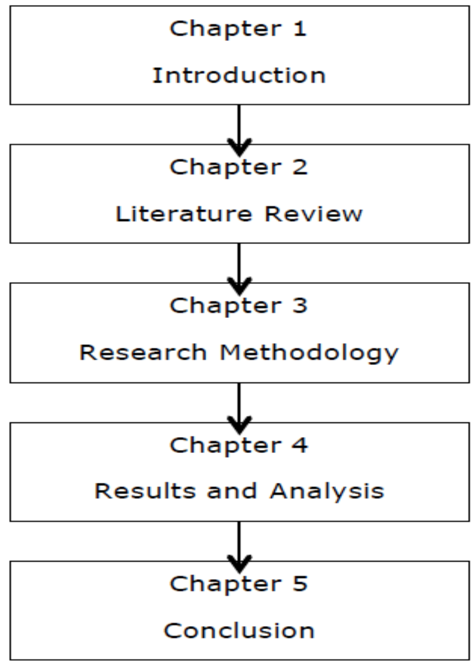


Figure 1.1: Thesis arrangement

In the next chapter, a detailed literature review on operational quality and its critical factors is presented.

CHAPTER 2 LITERATURE REVIEW

"A researcher cannot perform significant research without first understanding the literature in the field (p.3) - Barahona (2008)

2.0. Introduction

This chapter presents a review of the relevant available literature on topics that underpin this study while bringing the reader up to date with the existing and current literature. Divided into five parts, this review begins with perceptions of quality, what quality means to the oilfield industry and highlighting the fact that the industry has long focused on equipment, process and people in relation to quality improvement. The second part is a discussion on empowerment aimed at recognizing aspects of empowerment that might be explored for significance in the industry. Parts three and four highlight relevance of process and maintenance while efficiency is discussed in part 5. A discussion on how employee empowerment, maintenance and process contribute to operational quality is also highlighted in this chapter.

2.1. Part One - Quality

> "Quality is an honest to everything profit maker. Every penny you don't spend on doing things wrong, over, or instead becomes half a penny on the bottom line". -*(Boote and Beile, 2005, p.1)*

2.1.1. Overview of Quality

Quality is an intricate construct comprising numerous attributes, and approaches to defining it are varied for the most part (Noronha, 2002; Hansen, 2001). In day-to-day usage, the concept of quality takes different meaning from luxury to value

(Reeves and Bednar, 1994), expression of excellence (Reeves and Bednar, 1994, Garvin, 1984), to superiority (Zeithamal, 1988).

In a study to ascertain the perception of quality based on five identified definitions, conducted by Hansen (2001), it was observed that there were differences in understanding from both the organizations and the customer point of view, going by the ranking of each interpretation. This supports the view of Schonberger (1989) wherein quality is likened to an art that everybody recognizes when they see it, but is defined differently by each person (p.157).

These different perspectives and non-unanimous definitions are also seen in academic literature on quality, covered by four major fields of study – philosophy, economics, marketing and operations management. Philosophy focuses on the aspect of definition. Economics highlights profit maximization and market equilibrium. Marketing projects customer buying-behaviour and satisfaction, whereas for engineering practices and manufacturing, the focus of operations management is control. The result has been "a host of competing perspectives, each based on a different analytical framework and employing its own terminology" (Garvin, 1984 p.25). Nevertheless according to Hansen (2001), the use of the same word for different realities may be explained by the claim of socio-linguists that conceptualization equates with one's reality, whereby ambiguity reflects how multiple actors express their experiences of multiple realities.

Adopting a philosophical approach, Kasper et al. (1999) says quality is "an ambiguous term. On the one hand everybody knows (or thinks they know) what quality is. On the other hand, formulating a comprehensive and uniform definition is a big, if not insurmountable, problem...." (p.184). The philosophical approach associates quality with innate excellence like achievement of desirability or superiority, and no more. Agreeing, Garvin (1988) considers this philosophical approach a 'transcendent view' and an ultimate guiding principle for developing applied definitions of quality based on product, manufacturing, user and value (pp.39–48). Authors such as Schneider and White (2004) adopted a technical approach in the definition of quality, considering it from an objective and absolute point of view - thus portraying quality as measurable and conforming to technical standards. According to Schneider and White (2004), considering quality as either unknowable and immeasurable is useless from either a research or practice perspective (p.10). Familiar icons for this approach, as noted by Andersson et al. (2006) and Green (Jr) (2007) include six sigma, total quality management and zero defects, all of which have found use in the oilfield service industry mainly under the umbrella term of quality management and improvement programmes (Asif et al., 2009).

Unfortunately, according to Hansen (2001), the diverse understanding of the concept of quality within academic literature hinders its recognition on a broader scale. According to Plenert (1996), "it is difficult to focus on implementing changes that will improve quality, if no one agrees on the definition of quality" (p.69). Therefore, it is up to each company to seek its own definition of quality and set the target for change and (or) improvement.

According to Hoyle (2001), two different approaches to achieving quality exist. The first is with a view to finding answers to what needs to be done for success to occur and the second what is needed to prevent failure. This implies a general definition of quality without promoting any specific formal improvement method. Hence the ensuing section 2.1.2 will explore evolution of quality in the industry as they sought to manage success and eliminate failures without necessarily exploring in detail the different quality methodologies.

2.1.2. Evolution of Quality in Oilfield Service Industry

Quality and its practice in the oilfield industry, according to Dale et al. (1990), Duncan et al. (1996) and Dale (1999), have evolved over four distinct stages or generations (Figure 2.0) which are progressively complex in implementation.

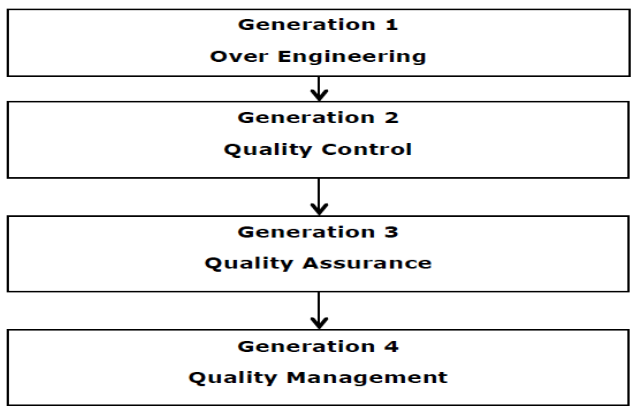


Figure 2.0: Quality Evolution
Source:Duncan et al. (1996)

According to Duncan et al. (1996), the predominant focus of the first generation was on design of *equipment* that will not fail. This was characterized by large safety margins and enabled by cheap materials and manpower. However, as materials became increasingly expensive and manpower remained comparatively cheap, these extra margins of safety were eliminated although equipment met specifications. Incidentally, the probability of failure increased, necessitating intense inspection as safeguard against delivering inferior products. As both materials and manpower became expensive, there was a reorientation toward understanding the *processes* to determine the causes of defects. Process control, which is the second generation, became the basis for minimizing the probability of failures and this finally evolved into a more proactive approach in which planning for conformance from the start was the fundamental principle. This second generation comprised methods to measure deviations from agreed-upon standard and rejection of large deviations. It is the overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer (IBS-America, 2012).

According to Hoyle (2001, p.59) "controls prevent change and when applied to quality they regulate quality performance and prevent undesirable changes being present in the quality of the product or service being supplied." However, according to Zirek (2011) the main problem with quality control is its 'end of line' approach resulting in an acceptable level of quality that might be less than 100% in practice, particularly because the check and correction are done after the problem must have arisen. This is unacceptable especially in high-risk organizations. According to quality guru Crosby Philip, as cited by Speegle (2009) and ORegan (2012) the issue with acceptable level of quality is that it creates a mindset that error is inevitable, necessitating a proposal for concentration on earliest possible detection and dynamic correction.

To address this proposal and overcome the appraisal-versus-failure dilemma, a focus on in-depth process analysis referred to as the 'beginning of line' is adopted, forming the third generation. With conformance as the key goal in this generation

(Heras et al., 2002), *people* are empowered for procedural adherence. People become the front liners and by doing so, good quality is ensured, and cost of quality, counted as the sum of failure, appraisal and prevention costs, begins to drop. In general, any company with a systematic program for personnel empowerment is following the quality assurance path. However for prevention to be effective, a feedback loop that enables constant refining of each process is implied.

Quality management, described as the planned, systemized set of activities to ensure that customer requirements are met (IBS-America, 2012) is the fourth stage in the evolution of quality and represents the current industry focus. This generation emphasizes personnel involvement in every step of the implementation and has also been described as a paradigm shift and a revolutionary philosophy of management aimed at improving total organizational performance (Andersson et al., 2006). Figure 2.1 below shows some quality concepts applied over the last decade.

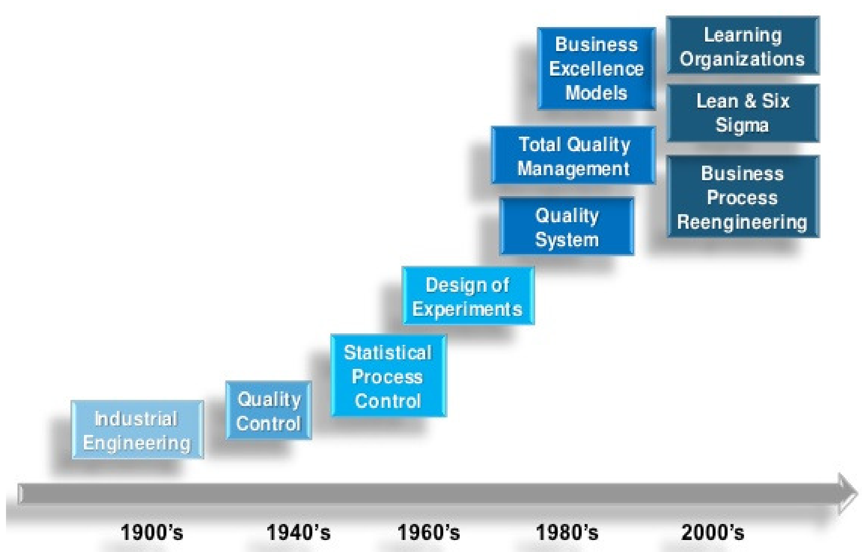


Figure 2.1: Quality Management Concepts over Time
Source: Operational excellence consulting, OEC (2012)

However according to Buell (2003) and Buell (2004) the quantification, understanding and documentation of benefits accruing from these statistical and quality initiatives are typically not at the optimum level in the oilfield industry. Nonetheless, to understand, analyze, and diagnose quality, all system components as well as their interrelationships should be analyzed (Dahlgaard-Park et al., 2013). The quality system components, according to practice in the oilfield service companies encouraged by international standard organization (ISO) include strategic maintenance, employee empowerment (competency), operations optimization (process) and quality management system in place (Nanda, 2016).

According to Gill (2009), in a market place with an exponentially advancing technological field, quality is a yardstick that every product will have to appreciate in order to go through the labyrinths of market place. When an organization reliably and consistently produces services and products that invoke a pleasurable experience, provided with little waste, and is reliable over time - it is said to have achieved a quality advantage, which can save countless lives and trillions of dollars (Zirek, 2011). According to Zirek (2011) although such an advantage is difficult to achieve and maintain, organizations that constantly cultivate and gain such an advantage grow and prosper, and are the most reliable approach to being a great organization (p.28). A quality edge, according to Ryan (2004) in making an economic case for quality, "boosts performance in the short run by allowing the firm to charge premium prices and in the long run by enabling growth of the firm through both market expansion and gains in market share" (p.2)

The contributions of personnel empowerment, process and equipment maintenance to quality is discussed below in section 2.1.3.

2.1.3. Role of Empowerment, Process and Maintenance

Within the oilfield services, flawless execution means doing it right the first time, every time. However, achieving this has been no small challenge. The significance of employee empowerment, process and equipment maintenance focus to operational quality performance is viewed in the light of its contribution to eliminating red money and to the achievement of key quality performance indicator (Mansour et al., 2013a, Bulent et al., 2000). Key Performance Indicators (KPI), by definition, means a quantifiable measure of a given attribute of an organization, process or product that is vital to its success (Parmenter, 2007). Figure 2.2 is a representation of the position key performance indicator holds in the performance measure.

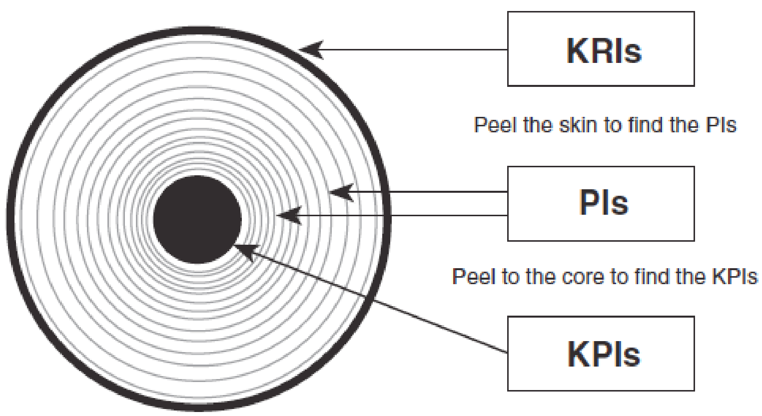


Figure 2.2: Three Types of Performance Measures

Source: Parmenter (2007)

Note: KRI = Key result indicator; PI = Performance indicator

Although KPIs will differ depending on the organization, the commonality will be attributed to the three factors as follows:

1. KPI will reflect the organization's goals
2. KPI will be a heavy contributor to an organization’s success
3. KPI will be quantifiable (measurable)

Fundamental to the quality culture is the belief that eliminating service quality incidents is dependent on measuring and managing incidents in order to determine root cause(s) and prevent reoccurrences. Non-productive time, which is usually unplanned downtime, is a measurable and manageable oilfield industry key quality performance indicator (Mansour et al., 2012, Mansour et al., 2013b) that could be very costly. Estimates in NPT, according to Clark (2013), runs from 15 to 40%, depending on well type and operator. NPT is the time in hours required to recover from a service quality (SQ) and (or) product quality (PQ) non-conformance. It is the time interval between the SQ and or PQ non-conformances and returning to the same position before the SQ and or PQ non-conformance occurred.

Examples of incidences that could constitute non-productive time include:

- Time required to repair equipment or to wait for backup equipment, unless normal operations are resumed.
- Time spent waiting on company in spite of adequate time and notice given before crew call out.
- Time spent fishing for lost-in-hole tool and equipment, if the cause of fishing is directly caused by equipment or personnel service quality non-conformance.

The dollar currency loss related to NPT is broken down into dollar loss to company, dollar loss to customer and dollar loss to a third party. All three dollar losses make up part of the total dollar loss involved in a service or product quality non-conformance. Red money is a pure loss for the organization involving money lost in such things as scrap, rework, wastes and retesting that directly reduces the company's profit and for which the customer is not willing to bear or offset (Limaye, 2009).

According to Perrin (2003), employees' willingness and ability to help their company succeed, largely by providing discretionary effort on a sustainable basis is by being engaged, a situation which according to Cohen and Higgins (2007), and Markos and Seridevi (2010) is highly created by employee empowerment. In Davies and Quinn (2016) view, empowerment is generally a subsidiary objective, subject to a higher goal such as improving quality; this higher goal itself being a subordinate to the ultimate goal of satisfying customer needs. From the foregoing, quality is a key driver for empowerment and according to Kaler (2016), the responsibility for quality is moved as far away from the centre as possible, to the empowered employee at the coalface.

Equipment maintenance has also been considered as one of the key contributors to quality (Bamber et al., 2004, Aoudia et al., 2008, Ben-Daya and Duffuaa, 1995, Ollila and Malmipuro, 1999). According to Campbell (1995), maintenance contribution to quality is interwoven in its objectives to minimize frequency and interruptions to operating processes. One of the key areas in which equipment maintenance has been beneficial is its associated set-up of an equipment maintenance program (Mukattash et al., 2011, Sullivan et al., 2010). The program, which is usually computer-based, enables reduction of non productive time, tracking of maintenance history for each asset and critical components, scheduled maintenance events to be proactively triggered, resource and materials planning, repository documentations and maintenance costs for reporting and analysis (Oil and Gas Eurasia, 2012). According to Mjema and Mweta (2003), introduction of computer-based maintenance system (CMMS) enables reduction in equipment downtime, reduction of overall maintenance cost and increase in productivity.

Maintenance system comprises of organizational structure, information system, management system and the maintenance personnel. Maintenance keeps an asset performing at the required standard to ensure continued capability and potentially eliminating the six equipment losses, namely, equipment failure, setup and adjustment, idling and minor stoppages, reduced speed, defects, and reduced yield (Nakajima, 1989, Nakajima, 1988). According to Riis et al. (1997), maintenance impacts delivery, quality and cost as it plays a role in keeping equipment fit, safe to operate and well configured to perform its task. In a research study by Sharp et al. (1997), the authors observed that equipment maintenance contributed to savings in excess of 200,000 pound sterling and a 50% increase in output to Thomas Bolton Limited Company, thereby increasing their capacity to meet customer need.

The establishment of processes has allowed the industry to standardize how work is done enabling a uniform potential for quality operation across the organization. It provides visibility into areas of quality, productivity, cost and schedule. Processes improve communication and understanding. According to Reed (2007), processes embody lessons learned from individual or organizations, thus becoming a checklist to ensure internal control and quality. The right people working on the right equipment with the right process are a significant contributor to quality of operation.

Table 1.0 summarizes contributions of personnel psychological empowerment, process and equipment maintenance to operational quality.

Table 1.0: Contributions to Operational Service Quality

Situation	• Declining asset uptime - risk of equipment failure and reduced production output • Expectation to "achieve more with less" – organizations are expected to maintain margin by reducing costs and meet stakeholder expectations • Employees view of operational excellence – mismatched priorities between organization and employees	
Impact	• Instability in achieving production targets becomes an issue, risking production revenue • Inability to identify savings from existing contracts • Without continuous improvement, organizations can't capitalize on ideas and leverage leading practices	
Contributions to operational service quality	Personnel empowerment (Bowen and Lawler 1992, 1995; Lawler, Mohrman and Ledford 1995)	• Enhances the technical knowledge and capability of employees, enabling tasks to be performed more effectively • Generate savings through identification of duplicate, erroneous and substandard practices. • Improve project performance by implementing best practices and creating standardization across projects. • Empowered for clear decision making that enables quality operation • Engages in a relentless pursuit of excellence via zero defect approach to product quality
	Process (Akyar (2012) Antonsen et al. 2008; Hancock and Parasuraman 2002)	• Captures data and leverages continuous improvement to compress repetitive processes and maximize efficiency. • Outlines how processes, people and systems interact to support the quality performance goal and how they are arranged and prioritized to achieve optimum efficiency. • Ensures all core activities are done consistently and in most effective way to achieve and sustain measurable results. • Identifies areas for improvement while ensuring conformance • Needed to develop plans, establish budget, oversee schedules, control capital investment and operating expenses, meet timetable
	Equipment maintenance (Campbell, 2006, Nakajima 1998, Hoffman (2002)	• Enables operation readiness planning • Improve reliability and performance through asset reliability and integrity management • Identifies potential asset/equipment failure for elimination • Tracks and provides foundation for investigating failures for improvement • Focuses on equipment life cycle from design to decommissioning • Established metrics and dashboards provide performance optimization capabilities • Enables reduction of operation costs directly attributable to equipment service and repair

2.1.4. Quality Literature Critiqued

A key observation from most of the literature on quality reviewed is the change in conversation from that of quality concept to quality programme, almost entirely suggesting that quality cannot exist on its own outside of a quality programme. This implies that the simplicity of quality has been lost with the varied and numerous initiatives proposed, so that its implementation is more complex than ever. This observation echoes Karapetrovic (2003) view, who put forward an expanded definition of quality to mean the "ability to deliver excellence to all interested parties" (p.6). This implies that it is no longer sufficient to focus only on customer satisfaction as was the bane of traditional quality assurance, but consideration needs to be given to other performance aspects like operations and finance. This is supported by Asif et al. (2009) who affirm that in this hyper competitive environment, recent models and programmes for quality improvement are structured around this wider definition of quality. According to Dahlgaard-Park et al. (2013) quality management is at a more mature and advanced stage with a shift in focus from just total quality management, to the tools, techniques and core values needed to implement quality management, and build a quality and business excellence culture.

Crosby (1979), in his study of quality as a source of competitive advantage, concluded that it is the "tacit, behavioural, imperfectly imitable features such as open culture, employee empowerment and executive commitment that produce advantage" (p.1). These tacit resources in Crosby's view drive quality success and organizations that acquire them can outperform competitors with or without the accompanying ideology of programs such as the total quality management.

According to Belohav (1995) “what makes quality the touchstone of competitive strategy is; it creates choices and opportunities not available to an organization’s competitors. Quality provides a different perspective and the potential to put an organization on a different competitive plane than its competitors. From a strategic perspective, the company determines whether and in what manner the quality advantage it has created will be used. Thus the link between quality and corporate strategy is, simply, that quality creates the ability for an organization to take actions that are literally impossible for its competitors” (p. 57).

Quality is an embedded part of the primary activities that represent the building block by which a firm creates valuable products and services. Hence, in this study quality will take on the simple but all-encompassing meaning of ‘attention to detail’ which according to O'Reilly et al. (1991) can be viewed with respect to ‘precision’ and ‘accuracy’ in performance.

2.2. Part Two - Empowerment

“Without mental transformation, the actions we take to change may only produce a new place where we continue to do our old things” (Crosby, 1979)

2.2.1. Overview of Personnel Empowerment

Amongst the many things employees’ value in today’s workplace is empowerment. This is according to a survey conducted by McCrindle (2012) shown in Table 2.0, comparing yesterday’s and today’s employees.

Table 2.0: What today's employee's value in the workplace

Yesterday's employees	**Today's employees**
Work ethic	Work/life
Bank balance	Life balance
Task focus	Team focus
Commitment	Enjoyment
Authority	**Empowerment**
Independence	Support
Structure	Flexibility
Tell them	Involve us
Conformity	Creativity
Tradition	Innovation
Regional	Global
Long careers	Many Jobs
Learn then earn	Lifelong learning
Loyalty	Variety
Below the line	Above the line
Participation	Ownership

Source: McCrindle (2012)

Empowerment as a concept has been a topic of intense research by academic scholars and organizations. Yet according to Hudson et al. (2000) "employee empowerment or participative decision-making is neither a new or simple management concept" (p.45) The research interest centers on the perceived inherent potential benefit in the area of increased commitment, high job satisfaction, improved quality and better decision (Yukl and Becker, 2006) which, Lawler et al. (2001) posit as reason for which over 70 percent of Fortune 100 companies adopt one form of empowerment practice or the other.

In the oilfield service industry, the employees who sometimes are the service themselves, work in teams or individually and for the most part, far away from the office. They are in the field; face-to face with the customer, where decisions need to be made fast and quickly as the cost of delay may be huge, thereby making the need for empowered personnel crucial for this high process industry. According to Steve Miller (Ex CEO, Shell Oil company 1999-2002), "the actual solutions about how best to meet the challenges of the moment have to be made by the people closest to the action – *[or what he calls]* the people at the 'coal face' ".

A study by Al-Harthy (2008), using Omani oil and gas companies as case study, revealed that 41% of employees were involved in key decision making as against 42% that were not, while 17% were neutral. In terms of empowerment, 35% acceded to being empowered while 36% felt their ideas and (or) suggestions were not welcome by management. This result is depicted in Figure 2.3 below, where the blue colour band depicts percentage of positive response, white depicts percentage of neutral response and red depicts percentage of negative response to questions asked.

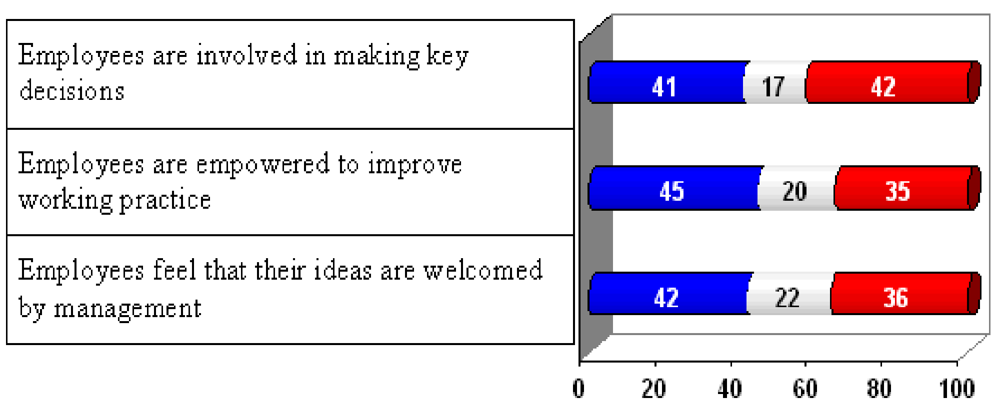


Figure 2.3: Empowerment in Omani Oil and Gas companies

Source: Al-Harthy (2008)

Empowerment, as a multidimensional construct is exercised at various levels and domains; individual, state, community or market level. Research suggests that empowerment exists when companies exercise distribution of power and rewards, sharing of knowledge and information throughout the organization (Kanter, 1986, Bowen and Lawler, 1995, Prasad, 2001). This is made possible through decentralization of decision-making, encouragement of information sharing and autonomy. These suggested practices have all found use in the oilfield service industry, some of which are in the form of employee stock ownership plan (ESOP), performance share plan (PSP), discounted stock purchase plan (DSPP), performance incentive plan (PIP), parallel power share structures, self-managed teams, etc. One critical highlight of this plan in terms of empowering employees is the notion of instilling owner awareness.

However, Spritzer (2001, p.6) argues this stance, stating that such perspective "does not address the nature of empowerment as experienced by employees as it provides an organizationally centric perspective on empowerment". The author maintained that in some cases, the employee feels disempowered in spite of the empowerment tools provided while in other situations, even in the face of disempowering work environment, individuals still feel/act empowered. So what then is empowerment? A selection of definitions on empowerment from pioneer researchers is examined below.

2.2.2. Empowerment Defined

According to Byham (1992) "empowerment is a feeling of job ownership and commitment brought about through the ability to make decisions, be responsible, be measured by results, and be recognized as a thoughtful, contributing human being rather than a pair of hands doing what others say." This results in the individual taking initiative in the interest of the organization without being nudged, prodded or micro managed just like a business owner would (O'Toole and Lawler, 2006). Maccoby

(1999) as cited by Khong et al. (2013) posits that, "the word 'empowerment' has two unique meanings. First, it means investing authority in a role or person and secondly it means enablement" (p.4863). Conger and Kanugo (1988) argue that empowerment has been used to describe a variety of interventions as well as the presumed effects of the interventions themselves on workers. They suggest that the term empower be defined from the perspective of motivational processes thus providing research path to study the effects and mechanism of different empowerment interventions.

Deriving from above definitions, it is seen that organizations with a total quality management focus devise ways like delegating of power and allocation of resources, to encourage employees in taking motivated decisions on quality related issues (Ugboro and Obeng, 2000, p.249). According to Blenko et al. (2010) the nature of organizational structure highlights where the decision-making authority lies. Although the three case companies studied for this thesis may be said to adopt a hierarchical structure with high-ranking personnel situated at the top of the chart above their direct reports, the design is such that they are structured to benefit from both a centralized and decentralized organizational design. This hybrid, called a matrix structure, groups individuals by their common skill-set (the groups in which they work) and reporting structure with the matrix chart outlining the roles, responsibilities and relationship between personnel depicted. Hybrid structure presents great advantage in practice although it has been argued that theoretically, there is an inherent ambiguity about where decision-making authority lies (Hopkins, 2012). Hybrid structures facilitate rapid response to change and emerging opportunities, enable shared resources, are flexible and permit more efficient information exchange. The structure is characterized as enabling improved employee motivation and empowerment which arises due to decision making within groups resulting in a more participatory workforce that are more likely to experience greater commitment to the goals of the organization (Kramer, 1994). Because the matrix structure boasts of a flatter structure, management is more involved and better informed of operations of the company.

According to Knight (1977), whereas decentralized model enables less accountability, conversely in a matrix model, staff are accountable through both functional and asset management hierarchies. This form of dual accountability, according to Hopkins (2012), slows decision-making, leading critics to call it ‘clunky’. Nevertheless, its advocates argue that it delivers the advantages of both the decentralized and the centralized organizational structure. Hence, while decentralized model might work well for organizations in less hazardous activities, it is not suitable for the oil and gas industry (Hopkins, 2012). The hybrid structure is widely adopted amongst oil and gas multinational companies (Chi and Nystrom, 1998).

In both non-management and management literature, empowerment has been defined differently, which according to Yukl and Becker (2006) even adds more complexity to its implementation, observing that most of the so-called empowering programs are never truly empowering. This implies that development of empowerment initiatives that can deliver sustainable organizational change is hindered by the lack of clear explanation on how empowerment constructs are formed and influenced at individual level. Some of the varied definitions of empowerment adapted from various literatures are shown below.

Gosh (2013):

> *“...Process of shifting authority and responsibility to employees at lower level in the organizational hierarchy” (p. 95)*

Thamizhmanii and Hasan (2010):

> *"...A concept that links individual strengths and competencies, natural helping systems and proactive behaviour to social policy and social change" (p.205)*

Alsop et al. (2006):

> *"A group's or individual's capacity to make effective choices, that is, to make choices and then to transform those choices into desired actions and outcomes" (p.10)*

Ramasamy (2005):

> *"An organizational state, where people are obliged to direct business and understand their performance boundaries, thus it enables them to take responsibility and ownership while seeking improvements, identifying the best course of action and imitative steps to meet customer requirements" (p.206)*

De Macedo-Soares and Lucas (1995):

> *"Delegating authority and responsibility to the lowest appropriate level for decision-making and reaching the business' goals. It essentially consists in allowing people to have a say in decisions about significant aspects of their jobs and the processes they are involved in, and to put into practice their ideas and plans in keeping with the business's customer-driven strategic objectives. However, it also means enabling people (both, leaders and subordinates) to assume increased autonomy by developing and channelling their talents, competencies and skills through training and education, with consistent performance appraisal and compensation systems, and by granting them the necessary time and appropriate information, financial and technological resources. It implies new leadership values and a supportive organizational culture." (p.477)*

Clutterbuck and Kernaghan (1994):

> *"Term of encouraging and allowing employees to take personal responsibility for any improvement brought about in the performance of their assigned task whilst contributing to the attainment of the overall objective of the organization." (p.12*-13)

Sibson (1994):

"Delegation of authority by the managers to each employee, mostly with respect to job practices and methods." (p. 21)

Bowen and Lawler (1992):

"Sharing with front-line employees information about an organization's performance, information about rewards based on the organization's performance, knowledge that enables employees to understand and contribute to organizational performance, and giving employees the power to make decisions that influence organizational direction and performance.''

Cornwall and Perlman (1990)

"The process of having power given from the traditionally powerful managers in an organization and instilled in everyone." (p. 87)

Thomas and Velthouse (1990)

"To empower means to give power to. Power, however, has several meanings. In a legal sense, power means authority, so that empowerment can mean authorization. Power also may be used to describe capacity, as in the self-efficacy definition of Conger and Kanugo. However, power also means energy. Thus, to empower also can mean to energize" (P.667)

Zemke and Schaaf (1989):

"Turning the front line loose, and encouraging and rewarding employees to exercise initiative and imagination. It is in many ways the reverse of doing things by the book" (p.68)

Conger and Kanugo (1988):

"A process of enhancing feelings of self-efficacy among organizational members through the identification of conditions that foster powerlessness and through their removal by both formal organizational practices and informal techniques of providing efficacy information" (p.474)

Peter Block (1987)

"Empowerment is a state of mind as well as a result of position, policies and practices" (p.68)

The varied definitions of empowerment enumerated above highlight varied antecedents or components of empowerment, as well as emphasize the purpose and process of empowerment. However, depending on the research focus, employee empowerment can be measured via two constructs, which includes the psychological empowerment construct (Thomas and Velthouse, 1990, Spreitzer, 1995) and empowerment climate construct. The psychological empowerment differs from the structural/environmental concept of empowerment in that it focuses on intrinsic motivation rather than on the managerial practices used to increase individuals' levels of power (Spreitzer, 1995). According to Yukl and Becker (2006), psychological empowerment is "the perception by members that they have the opportunity to help determine work roles, accomplish meaningful work, and influence important decisions" (p.210). Diener and Biswas-Diener (2005) argue that internal drive to act and feeling of competence are important for empowerment, though not without certain external conditions.

For the purpose of this thesis, empowerment describes the energy, ability and authority the employee has to confidently work on their own to increase quality, aligning with Thomas and Velthouse (1990) views of empowerment. This view implies that organizations that are able to generate that empowerment energy within their employees and tap into it will most likely have a significant effect on its quality success.

2.2.3. Understandings of Empowerment

As earlier shown in Table 2.3, many definitions of empowerment exist. However this study will highlight some of the varied understandings of empowerment and their criticisms regardless of field of study or discipline in which it is discussed.

2.2.3.1. Empowerment as a State of Mind

Empowerment has been viewed as synonymous with state of the mind (Mohammed and Pervaiz, 1998). Mohammed and Pervaiz (1998) argue that an empowered state of mind positions an employee to experience accountability for their work deliverables, sense of shared stake in company performance, appreciation of contribution-reward relationship and control over own job tasks. Spreitzer (2007b), (p.6), view empowerment as "a set of psychological states that are necessary for individuals to feel a sense of control in relation to their work", leaning strongly on employees personal beliefs and dispositional traits. Spreitzer (2007b) expanded Thomas and Velthouse (1990) view to reflect empowerment as intrinsic motivation manifest in cognitions and influenced by work environment.

2.2.3.2. Empowerment as a Process

A number of researchers have viewed empowerment as a process (Wallerstein, 1992, Whitmore, 1988). Nevertheless, while the nature of the process may be different, a positive empowerment or negative disempowerment process is recognizable by all. Empowerment is considered an enabling process that enhances change-driven decision making, especially when resources and prospects are jointly allocated (Hage and Lorensen, 2005). Keiffer (1984) identified four stages of empowerment process namely entry, advancement, incorporation and commitment. The first stage, the entry stage is associated with an act of provocation enough to motivate the individual. The advancement stage will require mentoring, supportive peer relationships and socio-political relation understanding to continue the empowerment process. The growing consciousness in the third stage makes way for the final stage of commitment in which the individual puts in practice his participatory competence. To Weick et al. (1999), empowerment is not just a mere process, but that process through which most of individual and social objectives can be accomplished if more effort is spent by social workers, psychologists and others in studying and applying it. Luke et al. (1991) consider empowerment as a moving target with constantly changing contexts, suggesting that empowerment be seen as "a process of change" rather than a "set of finite end results" (pg. 39). The authors, Luke et al. (1991), further stressed that different expectation of result of an empowerment process means that outcome measures are the only ones that can begin to satisfy different stakeholders.

2.2.3.3. Empowerment as Relational Concept

Empowerment is considered relational in that it happens in relation to an interaction between persons. It entails sharing of authority, decentralization of decision-making power and employee participation. Thus, just like power, it is a function of the dependence and interdependence of the parties involved. Burke (1986) description of the word empower implies power delegations. When dependence of one party on another becomes more than the other party's, then it suggests that the one who is depended upon more has power over the dependent. This is similar to Fletcher (1998)'s idea of mutual empowering, which entails behaviours that enable others' achievements and contributions (p.170). Bacharach and Lawler (1980) argue that this power over others is due to one's position/authority, personal demeanour, the individual's expertise and wealth of knowledge/information.

2.2.3.4. Empowerment as a Motivational Concept

As a motivational concept, many questions arise whether motivation really equates to empowerment. There is an assumption that individuals have an internal need to control and influence others. In order words, there is an intrinsic need for self-determination (Deci and Ryan, 1985) and a belief in self–efficacy (Bandura, 1997). This motivational disposition when assuaged or dissuaded by any empowerment technique creates a sense of powerfulness or powerlessness respectively. Thus, an enabling environment can be motivating yet not empowering.

2.2.3.5. Empowerment as an Outcome of Participation

The contention with this understanding is whether participation is a means of empowerment or an outcome in itself. According to Jupp and Ali (2010), the implication of participation as a means is that it does not seek to address issues of unequal power as compared to participation as an end. However, the authors maintain that participation must function both as a means, since development projects must produce some outputs, and as an end inasmuch as empowerment is viewed as a necessary outcome (p.537). This ambiguity becomes contradictory when emphasis is laid on participation as a means at the expense of participation as an end.

Cooke and Kothari (2001) have also challenged the drive towards using participation as the main avenue for community empowerment and demands at best their "rethinking if not their abandonment" (p.2). The authors argue that making participation compulsory may degenerate to a mere tick in the box, and could foster a 'participation by command' culture.

2.2.4. Components of Psychological Empowerment

Empowerment has often been conceptualized and operationalized in terms of sub-dimensions (Conger and Kanugo, 1988, Thomas and Velthouse, 1990, Spreitzer, 1995). Five notable empowerment models from five reputable authors include: first of all, Conger and Kanugo (1988) five-stage model of empowerment process which involves

- Diagnosis of organizational conditions that are responsible for feelings of powerlessness
- Techniques to remove some of the conditions leading to powerlessness
- Providing subordinates with self-efficacy information
- Resultant subordinates feeling of being empowered and
- Behavioural effects of empowerment

Secondly, Thomas and Velthouse (1990)'s cognitive model of employment, which is an improvement on Conger and Kanugo (1988)'s model, identifies meaningfulness, competence, choice and impact as basis of employee empowerment, and develops a model that captures the process by which employees arrive at these.

The third model is Altizer (1993)'s four-stage empowerment model which identifies review of employee authority level, delegation, innovation encouragement and recognition and reward of employee action as ways managers can adopt empowerment.

The fourth model is that of Thomas and Tymon (1993)'s 'empowerment inventory' model which highlights four feelings of empowerment namely; feelings of choice, feelings of competence, feelings of meaningfulness and feelings of progress in its empowerment grid.

The fifth model, which is Spreitzer (1995) model with dimensions of impact, competence, meaning and self determination, validates and develops a multidimensional measure of empowerment in the workplace supporting Thomas and Velthouse (1990)'s four distinct dimensions of empowerment.

The four main factors proposed in the Thomas and Velthouse (1990) model which are referenced quite often, suggesting being most widely adopted, are discussed below.

Meaningfulness – Meaning of work has been historically argued to be the product of one of three forces (Wrzesniewski and Dutton, 2001) namely:

1. The work environment, including design of job and reward structure, that affects level of satisfaction derived from a particular job by an individual.
2. Psychological attributes of individuals, which determine the meaning of work for such individuals.
3. Social environment, which includes managers and co-workers that help individuals in their work place experience formation.

Thomas and Velthouse (1990) nonetheless define meaningfulness as "the value of the task goal or purpose, judged in relation to the individual's own ideals or standards; the individual's intrinsic *caring* about a given task" (p.672). It is the individual's perceived self-worth of the job (Spreitzer, 1995). Brief and Nord (1990) support the idea of meaningfulness being an employee thoughts towards himself and the work, whereas Wrzesniewski and Dutton (2001) contend that individuals play an active role in creating the meaning of their work through small changes they make in task, relational and cognitive boundaries of the work.

According to Spreitzer (2007a), meaningfulness is the engine of empowerment that energizes individuals to work. This view implies that a task or goal deemed meaningful by the employee will almost likely attract the utmost attention and urgency up to completion. This understanding is similar to the theory underpinning Hackman and Oldham (1980) job characteristics model in which the authors suggest that "individuals will be internally motivated to perform well when they experience the work as *meaningful,* they feel they have personal responsibility for the work outcomes, and they obtain regular and trustworthy knowledge of the results of their work" (p. 447).

According to Thomas and Tymon (1993), meaningfulness is the opportunity one feels to pursue a worthy task purpose. The authors maintain that the feeling of meaningfulness is the feeling that one is on a path that is worth his/her time and energy – that one is on a valuable mission *and* that his/her purpose matters in the larger scheme of things.

Meaningfulness is also described as "the sense made of, and significance felt regarding, the nature of one's being and existence" (Steger et al., 2006, p.81). Pratt and Ashforth (2003) argue that attributes of a job and the meaning enjoyed at work enhance meaningfulness. Meaning involves a comparison between the requirements of a work role and an individual's beliefs and values such that the individual perceives the task to be of value to him/herself (Sigler and Pearson, 2000).

Meaning has also been linked to work-place spirituality (Duchon and Plowman, 2005) which is defined "as a particular kind of psychological climate in which people view themselves as having an inner life that is nourished by meaningful work and takes place in the context of a community" (p.816). They argue that spirituality and meaningfulness are linked since the search for meaning defines individuals as spiritual beings. Dehler and Welsh (1994) define spirituality as "a specific form of work feeling that energizes action" (p.19). However, this spirituality in the view of Bernard Alpaerts, an ex-employee of Schlumberger, as cited by Auletta (1985), is on the decline as a result of "materialism, insecurity and weakened bonds of trust that plague industrialized society" (p.163). Hindrances to meaningfulness and purpose at work exist at individual, organizational and societal levels.

According to the USA 2012 Employee passion survey report by Integro Leadership Institute (2012), 'meaningfulness comes from knowing we are doing something worthwhile—that we are making the world a better place for others'. The report stated that, "when employees understand the purpose of their work and how it makes a difference to others, they reach a higher level of engagement and commitment" (p.5) hence, a great sense of passion for what they do. To help enhance feelings of meaningfulness, Thomas and Tymon (1993) suggests the creation and communication by higher management of an exciting vision (p.13). This building block stresses the purpose of the task and how it would add value to the world hence nurturing the sense that one is on a valuable mission in the pursuit of a higher cause. Higher management has a task of sharing information, encouraging ideas and suggestions together with significant investment in training of employees at all levels and providing resources necessary to achieve the vision.

Competence – Thomas and Velthouse (1990) consider competence as "the degree to which a person can perform task activities skilfully when he or she tries" (p.672). This is comparable to the concept of personal mastery highlighted by Bandura (1986), which promotes the feeling of individual's capability to successfully perform a particular task or activity. According to Thomas and Tymon (1993), competence is the accomplishment you feel in skilfully performing task activities you have chosen. This feeling of competence, according to Thomas and Tymon (1993), involves the sense that you are doing good, quality work on task. This is similar to self-efficacy as described by Duchon and Plowman (2005), which expresses an individual's belief in his own capability to skilfully perform a task. In linking self-efficacy with empowerment, Gist (1987) stated that "perceived self-efficacy concerns people's beliefs in their capabilities to mobilize the motivation, cognitive resources, and courses of action needed to exercise control over events in their lives" (p.364).

Apart from self-efficacy, mentorship is another external reinforcement of perceived competency levels by the individual. According to Wood and Bandura (1989), a mentor's role include assisting the individual's belief in themselves, timely providing information, demonstrating initiative so that the person could envision new possibilities for self and challenging the person to become more productive.

The Oil and Gas UK gives a holistic definition of competency that ensures professional and safe operations in the oil and gas industry. Competency, according to the Oil and Gas UK, is the ability to undertake responsibilities and to perform activities to a recognized standard on a regular basis'. It is a combination of practical and thinking skills, experience and knowledge, and may include a willingness to undertake work activities in accordance with agreed standards, rules and procedures. This definition of competency breaks down into three basic blocks of skill, proficiency, and lastly, assessment and certification. Skills are what competent personnel possess through learning and practice, and are required to perform the job at hand. They are the skills that make up the profession and allow progress towards competency. Proficiency speaks of how knowledgeable and practiced an individual is in a particular skill. A proficiency scale takes that individual from beginner to expert. Most oil and gas oilfield service companies subscribe to four levels of proficiency from awareness only at the first level, to the ability to regularly perform the skill under the most varied and stringent conditions at the last. The third concept of assessment and certification focuses on how sure the organization can be that a given engineer really has reached a particular level. Such certification implies rigorous control, which would include a record of whether a skill has been recently practiced, and under which specific conditions it was practiced. Assessment and certification naturally implies that the individuals who certify the competence of others are themselves not only competent in the skill being assessed, but also competent as assessors.

These three basic blocks lend themselves to the definition of an entire holistic approach to competency. Nevertheless, a lot of what is seen amongst the low level employees can be labelled as routinized competence, and therefore routinized performance. According to Winter (1985, p. 111) as cited by Klein (2009), although routinized competence does not indicate inattention to considerations that fall outside of the scope of routine...the wider the range of situations subsumed by the routines and the better the routinized performance, the fewer reminders there are that something besides routinized competence might on occasion be useful or even essential to survival (p. 48).

Thomas and Tymon (1993) proposed positive feedback and growth opportunities as key ingredients for enhancing feelings of competence in the employee. According to them, employees build on what they do well with a more appreciative, success focused (positive) feedback than they do with a failure and deficiency-focused (negative) feedback. The authors further stressed that employees should be allowed to gradually take on more demanding and challenging tasks, and encouraged to suggest ways of improving job quality and productivity.

Choice – According to Thomas and Tymon (1993) choice is the opportunity one feels to select task activities that make sense to him and to perform them in ways that seem appropriate. It is the feeling of being free to choose – of being able to use one's own judgment and act out of one's own understanding of the task. Liden and Tewksbury (1995) describe the degree of freedom to make a choice at work place as a fundamental aspect of empowerment. According to Lord and Hutchison (1993), choice is the "causal responsibility for a person's actions and whether behaviour is perceived as self-determined" (p.211). This is comparable to the concept of locus of control introduced by Rotter (1990) which argues that individuals oriented towards internal locus of control tend to arrogate the determination of events in their lives mostly to the actions they take instead of to chance. On the other hand, individuals oriented towards external locus of control see fate/chance as the determination of events in their lives. Both Spreitzer (1995) and Deci et al. (1989) both use the term 'self-determination' which, according to the latter, is a situation where an individual recognizes and exercises own choice of when and how to initiate work tasks. To build the feeling of choice, Thomas and Tymon (1993) stressed that managers foster trust and security by "supporting members' experimentation," *(and)* passing out "no blame/punishment for honest mistakes" (p.11) in the pursuit of continuous improvement. In other words, as the individual gains expertise, he is allowed more latitude or considerable opportunity for independence and freedom in how they perform their job. Furthermore, participation in setting goals and objectives for their jobs enhances feeling of choice.

Impact – Impact according to Spreitzer (1995), means "the degree to which behaviour is seen as making a difference in terms of accomplishing the purpose of the task; that is, producing intended effects in one's task environment" (p. 672). Impact is premised on the belief of an individual's influence on organization-level policy (Rotter, 1966). For Hackman and Oldham (1980), impact is synonymous with the state of knowledge of an outcome whereas Ashforth (1989) recognizes impact as the influence level an individual wields on strategic and operational objectives in a work place. In developing an empowerment inventory model, Thomas and Tymon (1993) equated impact with progress, defining it as the accomplishment you feel in achieving the task purpose. The feeling of progress involves the sense that the task is moving forward, *(and)* that your activities are really accomplishing something (p. 9). One key way of promoting the feeling of impact is by promoting the feeling of continuous improvement (Thomas and Tymon, 1993), which is central to quality. This could be done with customer feedback and serves as a powerful employee motivator, rewarding workers for the successes of past efforts and encouraging them to continue to use their creative energies to improve the system. Furthermore, employees' ideas and opinions are sought when change is considered and planned to enhance feeling of significant influence over what happens in the organization.

Another approach to empowerment involves three components – responsibility, accountability and mindfulness.

Accountability – Accountability, according to Hall et al., (2003), is "an implicit or explicit expectation that one's decisions or actions will be subject to evaluation by some salient audience(s) with the belief that there exists the potential for one to receive either rewards or sanctions based on the expected evaluation" (p. 33). It is the "perceived potential of being evaluated by someone and being answerable for decisions or actions" (Yukl and Becker, 2006) which may be linked with "principle of bureaucratic accountability - a system that rewards success and punishes failure" (Frink and Ferris, 1998, p.1260).

Accountability puts a form of check on the empowered employee, which may support Nwabueze (2001, p.401) stance that the empowerment reduces the requirement for supervisors, hence reduction in operating costs. This form of check may also explain Argyris (1998) observation that empowerment may be considered great by some employees when not associated with personal accountability. Nevertheless in the workplace, traditional or high performance, everyone is accountable to someone in some way. According to Willard and Hitchcock (2013), workers are individually accountable to their respective bosses in a traditional organization, whereas in a high performance organization team, members are individually accountable to each other and mutually accountable to their customers. In the experience of Becker et al. (1994), it is observed that employee motivation accounts for about 20% of performance improvement while the balance 80% is from compliance assurance, through reinforcement of consequence management. Invariably, transparency and accountability are ever more important. According to Shaffle et al. (2011), "improving operational efficiency works best in companies that either have a strong culture of accountability or would like to enhance it" (p.4).

Accountability generates ownership of decisions and projects, and enhances the sustainability of results (Blagescu et al., 2005). In the 2010 Macondo oil spill tragic incident for example, part of the reason for the poor decision made is what Hopkins (2012) termed " consensus-seeking', where majority consensus determined the course of action to be followed. This concept meant that no one was really accountable for the decision. Furthermore, Hopkins (2012) stressed that the "sheer number of verifiers and approvers that the Macondo team had only served to diffuse accountability for the final decision" (p.32). Ultimately, accountability provides a pathway to better performance (Blagescu et al., 2005). However McCreery et al. (2013), as well as Nwabueze (2001), hold a different opinion, implying that in such a system, "employees tend to find ways of obscuring issues and problems that will place them in a bad light; deflecting attention and covering up, as well as engaging in forms of impression management that makes the situation for which they are responsible look better than it actually is" (p.401).

Responsibility – Responsibility represents the assignment of task/role with attributes of meaning/value/importance/challenge to both employee and organization. In defining employee empowerment, Baird and Wang (2010) view responsibility as power delegation from higher to lower echelon of the organizational hierarchy, thus suggesting that empowerment implies control over resources and decisions. This notion of control and decision, according to Steve Miller - the ex-CEO of Shell oil producing companies from 1999 to 2002 - in an interview on grassroots leadership, is the scariest part for most leaders (Mak, 2000). However, Steve maintains in the interview that when the frontline staff takes ownership of the problem, they ultimately evolve solutions through creative and innovative thinking, exceeding whatever solution options the headquarters can ever come up with.

This view is upheld by Pascale (1998) wherein the author states that "empowerment embodies the belief that the answer to the latest crisis lies within each individual and therefore everyone must buckle up for the adventure" (p.345). According to Sage and Rouse (2011), "empowerment gives a sense of 'ownership' and when employees are empowered, there is a sense that 'everyone owns his/her piece of the business [which] unleashes the talent and energy of our people'' (p. 27). With respect to performance, Gregory (2009) maintain that while accountability fetters performance, responsibility enhances it, making both concepts two sides of the same coin.

Mindfulness - is another component that is being considered in the quality arena. Although the bulk of study of mindfulness has long been conducted in fields such as social psychology, the past ten years have seen increased quality research in mindfulness (Ndubisi, 2012a).

Mindfulness approach holds that the information gathering/processing pattern, thinking bias and adaptability propensity to changing environment by individuals/organizations influence their performance amidst unpredictable business climate Akers (1991). Mindfulness requires receptiveness to novelty, even at individual-level. It also requires analytical alertness, ability to make contextual distinction of events or people and appreciation of different perspectives on an issue (Langer, 1989). While people who are mindfulness-biased approach tasks with motivation, and take decisions after relevant situational analysis, those who are not tend to exhibit cognitive and straightjacket behaviours (Sternberg, 2000).

To achieve this sort of organization, Senge (1990) proposed five disciplines, namely, personal mastery, mental models, shared vision, team learning and systems thinking. However, these proposed disciplines have received some criticisms as to whether it fosters informed, committed action on the part of those it is aimed at or if it is simply too idealistic especially within capitalist organizations, where the bottom line is profit. Authors such as Maurik (2001) have argued that these ideas are insightful and revolutionary though, regrettably, more organizations have not taken advantage of it, hence have remained geared to the quick fix (p.201).

For organizational mindfulness, traits that enhance quality include attention to details, commitment to resilience, recognition of expertise and adaptation of failure analysis (Fiol and O'Connor, 2003, p.57 - 59). According to Weick and Sutcliffe (2007) and Weick and Sutcliffe (2001), these traits promote increased attention that is intense enough to highlight important details that could be missed, describing it as a preoccupation with failure. This view of preoccupation with failure can better be understood in relation to the Macondo incident. In developing a decision tree that guided the decision making process in the final stages of the well construction, the Macondo team omitted a critical step which involved the integrity testing of the well, giving credence to the assertion by Hopkins (2012) that they never conceived of its possible failure. By assuming this stance in which it was inconceivable to British Petroleum (BP) team for an integrity test to fail, the team were oblivious to the facts/evidence before them that stated otherwise. By focusing on the present, paying attention to operational detail, willingness to consider alternative perspectives, and an interest in investigating and understanding failures, individual and collective mindfulness are promoted (Weick and Putnam, 2006).

Mindfulness, in Langer (1999) and Langer (1989) view, is a quality-enhancer in contrast to mindlessness which is a state in which individuals engage in minimal processing of information that is relevant to current task (Ndubisi, 2012a), eroding quality. According to Timmerman (2002 , p.114), "mindlessness can show up as the direct cause of human error in complex situations". Ndubisi (2012a) strongly suggests that approaching work with a mindfulness bias can present a more sustainable solution to organizations on reliability and quality front, when compared to routine-base approaches like ISO 9000 and Six Sigma. These routine-based approaches, in Ndubisi (2012a) argument, leverage on elimination of waste in products and services to deliver value to customers.

Langer and Moldoveanu (2000) stress that unlike routine-based approaches, mindfulness-based approach "promote highly situated human cognition as the solution to individual and organizational reliability problem" (p.538). Rules and routines can result in mindlessness whereas mindfulness entails the participation of the individual since he is always alert. However Ndubisi (2012b) in his argument suggested that routinized competence (which is usually a fallout of rules) results in higher attention to anything that falls outside the scope of interest.

In studying high reliability organizations in environments with dire consequence for error/failure, Winter (1985) adopted the mindfulness approach. The study, as well as that done by Weick and Sutcliffe (2001), highlight the fact that mindfulness increases comprehension of complexity. However Weick et al. (1999) stresses that, "the pursuit of legitimacy through adoption of formal quality programmes neutralizes the mindful pursuit of reliability" (p.60) and in the effort to improve efficiency, the quality initiatives targeted at promoting mindfulness may become so routine as to be mindless.

Given these different components of empowerment which support different outcomes (Spreitzer et al., 1997), some *organizations*, according to Dveirin and Adams (1993), may wonder where to begin to focus leadership efforts (p.230). Hence this study seeks to bridge that gap in the oilfield industry by providing that focus.

2.2.5. Empowerment and Quality Relationship

Flynn et al. (1994) identified employee empowerment as a work force management practice that supports quality. The Malcolm Baldrige National Quality Award criteria link empowerment to "enhanced employee authority to act…such as when quality standards may be compromised". Thus in relation to quality, empowerment should be determined by asking employees about their perception of authority to act to increase quality (Hayes, 1994) as applied in this study with questions QN1-N6 in Appendix I. According to Ripley and Ripley (1992), empowerment is the glue by which the elements of customer focus, quality process and products, continuous improvements, self-managing teams, quality measurement, and utilization of the total workforce abilities are held together. Essentially, it is one of the most important principles of total quality management (Moyle et al., 2005) and strategic for operational service quality improvement (Berger, 1991).

This empowerment-quality relationship was postulated in the 1980s (Ishikiwa, 1985) and necessitated by growing global competition and the performance imperative to improve quality (Thomas and Velthouse, 1990, Bowen and Lawler, 1995, Conger and Kanugo, 1988, Spreitzer, 1996). Today, it is estimated that over 70% of firms globally have implemented several empowerment initiatives (Lawler et al., 2001) to improve job satisfaction (Savery and Luks, 2001, Kim, 2002, Lee et al., 2006), organizational commitment (Guthrie, 2001), innovativeness (Fernandez and Tima, 2013) and performance (Nielsen and Christian, 2003, Lee et al., 2006, Fernandez and Tima, 2011). It is important to note that some of these empowerment initiatives cover a wide range of arrangements that are discussed under the headings of participation and involvement as these are often used interchangeably in literature (Cotton, 1993, Plunkett and Fournier, 1991). For practical purposes however, the strategies that improve staff confidence and effectiveness in delivering task objectives are all part of employee empowerment (Ugboro and Obeng, 2000). Consequently, adoption of empowerment practices has continued to be a subject of great interest to researchers (Baird and Wang, 2010, Jarrar and Zairi, 2010), opening doors to research on leadership styles and management practices that have continued to evolve (Onyemeh et al., 2014).

The role of empowerment in quality setting is to generate the energy necessary to fuel the continuous quality improvement (Hatton, 1993). According to Block (1987), the source of all energy, passion, motivation, and an internally generated desire to do quality work is our own feeling about what we are doing. A corporate commitment to quality that is not based on intrinsic motivation is a house built on sand (Senge, 1992). Psychological empowerment in Senge (1992) argument makes people feel responsible for how well the work is performed and as a result motivates them to do high quality work because it satisfies their needs for competence and self-esteem. According to Lawler (1986), effective empowerment fosters high level of motivation in the workforce and result in better quality (p.31).

The concept of employee empowerment and quality according to Hatton (1993) exist simultaneously to one degree or another in many companies and this is indicated by past and current research. One such past study, conducted by Dr. Edward Lawler, specifically addresses this issue.

Edward Lawler (1992) studied the relationship between quality and employee empowerment using surveys with inputs from managers and senior executives of 313 Fortune 1000 companies comprising 50% service and 50% manufacturing companies with a median size of between 9000 to 10000 employees. The purpose of Edward Lawler's study was to determine how employee empowerment and quality are related in companies that have implemented them both.

To determine this, Lawler specifically asked the participants three questions on the subject: (1) Which of the two programmes started first? (2) How are the programmes managed and (3) How are these concepts viewed by management in the context of the company as a whole? The findings of his study showed emphasis placed on both concepts by leading businesses, indicating that 72% of the companies believe employee empowerment preceded quality, thus implying that quality was enhanced by empowerment. A further 68% of the companies indicate that both concepts are not managed as separate programmes but are linked together in a single integrated philosophy. In answering question 3, result showed that 76% believed that empowerment fosters quality leading Lawler (1992) to summarize his findings by stating, "employee empowerment…may be viewed as creating the organizational context needed to support quality improvement" (p.105) and concluding that "there is a close relationship between employee empowerment and quality improvement" (Lawler 1992, p. xvi).

In a separate study done by Bowen and Lawler (1992), it was concluded that empowered and motivated staff, with good view on service quality importance, typically deliver excellent service.

Byham (1988) pinpoints this relationship when he wrote that "in years to come, the successful organizations will be the ones best able to apply the creative energy of individuals toward constant improvement…(and)…the only way to get people to adopt constant improvement as a way of life in doing daily business is by empowering them" (p.viii).

Dveirin and Adams (1993) in detailing this aspect of empowerment and quality relationship stated that "the shift from compliance to continuous improvement requires abridged...empowerment...by which all employees can contribute their intelligence, knowledge, and experience in the service of full–circle thinking" (p.222).

This bridge from compliance to continuous quality improvement, according to Hatton (1993), will only be completed "when managers employ the interventions associated with empowerment as motivation, that is, actions designed to enhance a worker's intrinsic desire to produce a quality product or service" (p.23). The empowerment model by Thomas and Tymon (1993) facilitated the completion of this bridge with the provision of building blocks for pragmatic, hands-on-applications that have relevance on the shop floor.

Furthermore, data gathered during the interview process in a research study by Hatton (1993) indicates that empowerment and quality are seen as related and mutually supporting concepts with the conclusion that the effectiveness of either concept without the other would be severely diminished. Hatton concluded that the effective use of psychological empowerment interventions enabled the facility under study to maintain ‘starship’ status (p.30), a status that represents its quality focus and achievement.

Abdullah et al. (2008) examined the influence of four selected soft factors on quality improvement within 255 Malaysian electrical and electronic firms. The results showed that management commitment, employee empowerment, training and education, and reward and recognition are significantly positively associated with firms’ quality improvement practice. Furthermore, employee involvement was perceived as a dominant soft factor for quality improvement and was associated with significant improvements in firms’ quality improvement.

In conducting a review study on the quantity and trend of research on empowerment articles, Dahlgaard (2013) made the significant choice of start year for the review to reflect the start period the discourse on employee empowerment was put in perspective with the official launch of Malcolm Baldrige National quality award - major quality framework. Findings from the review suggest that study on employee empowerment have moved from organizational performance to individuals in recognition of the criticality of individual contributions to quality. This implied that the success of operational quality initiatives and focus relied on employee empowerment. According to Papavinasam (2013), “the success of each and every activity depends solely on the individual who puts their hands on the job. Whatever other measures taken, unless the individuals are motivated and execute the work properly, the integrity of the operation is compromised” (p. 825).

A number of workforce management practices which have found applicability in the oilfield industry targeted at empowering employees include: planning and organization, problem solving techniques, role and objective clarification, information dissemination platform/forum, monitoring, motivation and inspiration, consultation, delegation, support, development and mentorship programmes, conflict management and team building, networking, recognition and reward system (Yukl 1994). But Narayan (2005) argues that remedies such as selection of non-violators, detection, reporting, and incentives, all of which are part of empowerment, are less effective in achieving the desired result as they have side effects that negate the positive benefits.

The challenge weighs on creating an empowered state of mind or influencing empowerment perceptions of the personnel to the extent that the personnel indeed feels empowered and allows this feeling of empowerment to translate to their contribution to the company, namely, increased productivity and attention to detail, to mention a few.

Itabashi-Campbell et al. (2012) maintain that the ability and willingness of employees to take appropriate and timely action in redressing quality issues depends on the extent of employee empowerment. According to Craighead (2012), "an empowered workforce…..will enable world-class processes, procedures, technology, and competency-based training programmes to achieve the desired step change". Leaning on the understanding of social exchange theory by Cropanzano and Mitchell (2005), an empowerment enabling environment created by an employer tends to stimulate high commitment in the service employee as a means of reciprocity (Flynn, 2005, Wayne et al., 1997), leading in turn to a higher level of service quality. Hence, when the people aspects are poorly managed, improvement in quality will fail to yield their full potential (Dwyer, 2002).

According to Bettley et al. (2005), recent research on the relationship between empowerment programmes and quality programmes offers four conclusions as follows:

1. Employee empowerment programmes typically start before quality programmes.
2. There are comparable numbers of firms using each of three approaches to managing the two programmes - as two separate programmes, as separate but coordinated programmes, and as one integrated programme.
3. The image of the relationship between the two is usually that employee empowerment is part of quality improvement programme; far less often is total quality management part of an employee involvement programme. This may be partly due to managers' perception of total quality management as a more acceptable initiative that emphasizes work processes rather than issues of power and management style.
4. Total quality management and empowerment can reinforce each other to make a change effort that uses both programmes more successfully than one that uses either alone.

The challenge for any organization then is to diagnose its situation and decide which change process or combination of activities is most likely to be successful, and match them with particular change efforts (Bettley et al., 2005). Table 2.1 below summarizes some studies on quality/empowerment relationship.

Table 2.1: Various Studies on Relationship Between Quality and Empowerment

Citation	Case Industry	Mode of data collection/# of respondents	Research objective	Sample empowerment-quality question	Finding
(Madani and Ahmadi, 2015)	Service organization (Banking)	Questionnaires /120	Investigate the relationship between the dimensions quality of organizations operations and employee empowerment		The result (showing a validity of 0.86) shows that quality of organizational operation increases as employee empowerment increases.
(Degago, 2014)	Multiple sectors (4)	Questionnaires /102	Study of relationship between dimensions of empowerment and how well employee carries out the job.	Adopted questions based on the 4 dimensions of empowerment (choice, meaning, impact and competence)	The results showed that the empowerment dimension of meaning, competence self-determination, and impact is positively and significantly related to quality of employee performance.
(Alabar and Abubakar, 2013)	Service organization (Banking)	Questionnaires /185	Investigate the impact of empowerment on service quality	"Who takes responsibility when a service failure occurs?"	Employee empowerment has positive and significant impact on service quality.
(Lashley, 2012)	Service organization (3) (Food industry)	Interview	Investigate Empowerment as a strategy for service excellence		Employee empowerment appears to be a mechanism for achieving commitment and performance.
(Irechukwu, 2010)	Multiple sectors (9)	Mixed method/236	Quality improvement in a global competitive market place		If effectively put in place, employee empowerment is a critical factor for successfully achieving quality improvement.

Table 2.1: Various Studies on Relationship Between Quality and Empowerment (contd.)

Citation	Case Industry	Mode of data collection/# of respondents	Research objective	Sample empowerment-quality question	Finding
(Geralis and Terziovski, 2003)	Service industry (3) (Banking)	Questionnaires /320	A quantitative analysis of the relationship between empowerment practices and service quality outcomes	"Am I empowered in order to improve service"	The results (a strong correlation of 0.602 significant at 0.01 level) show that empowering the workforce is a powerful strategy that substantially improves service quality. Hence quality outcome are more dependent on empowerment.
(Terziovski and Samson, 1999)	Manufacturing Industry	Questionnaires /1024			Efforts in improved people management has a strongly significant relationship with the firm's performance
(Tschol, 1998)	Entertainment and Hospitality industry	Interview	Empowerment-key to quality service	Presents four myths of empowerment, and five suggestions to achieve empowerment	Recognizing and valuing employees decreases errors and turnover and increases productivity, enthusiasm and commitment – indeed, quality.
(Hayes, 1994)	Multiple sector (5)	Questionnaires /111	To design an employee empowerment questionnaire (EEQ) to measure the degree to which employees have authority to act on their own to increase quality	. I have the authority to correct problems when they occur. . I have a lot of control over how I do my job. . I do not need to get management's approval before I handle problems. . I am encouraged to handle job-related problems by myself.	The reliability factor (Cronbach's alpha) for the items was 0.85 representing empowerment-quality link as defined by Malcolm Baldrige Quality Award criteria.

2.2.6. Benefits of empowerment

According to Beer (2003), there are three core areas that benefit from personnel empowerment. These are

- Efficiency
- Creativity
- Motivation

In the area of efficiency, empowerment aids in a faster decision making process which in turn can lead to a faster response and productivity, a strategy which is a great asset in unpredictable environment. According to Bowen and Lawler (1992), businesses that operate in unpredictable environments benefit from empowerment. An empowering environment, Beer (2003) posits, enables creativity to flourish. This comes about as individuals are allowed to work independently fostering innovation and novelty, which in turn can lead to competitive advantage and a more sustainable future. The empowered employee feels more valued and so displays higher motivation.

2.2.7. Empowerment literature critiqued

The concept of empowerment have seen criticisms from mild (Mills and Simmons, 1995, Boje et al., 1996, Hirschhorn, 1997) to harsh (Jacques, 1996) with most centring on theory to operationalization. One key observation in the review of employee empowerment literature is the stress on the word 'power' within the concept of empowerment. However, though empowerment derives from real power, it is a process by which the latter is only bestowed to an end or for a purpose. For perspective, power according to Luke (2005) and Luke (1974) is the capacity not only to impose ones will, but also to set the terms of the agreement. These terms of agreement may be viewed as limiting or creating boundaries but McKenna and Mellon (2012) have argued that without existence of formal structures for worker ownership in a firm, many initiatives for empowerment may degenerate to disempowerment as power would still sit at the top management of the firm. However, Manz and Sims (1993) acknowledges that there are disempowering potential present in empowerment programmes.

Critics of psychological empowerment have also stressed that it is limited in that it is 'individually-centric' (Spreitzer, 2007a)(p.8) although Boje and Rosile (2001) found that there has been increasing focus on productive improvement and less on enablement of human welfare in many empowerment discourse. However, productive or quality improvement does not take place in a vacuum but is still achieved through humans who are beneficiaries of these empowerment initiatives enabling a win-win situation.

Furthermore, Spreitzer (2007a), in reviewing over 20 years of empowerment research, observed that practical mechanisms and processes by which empowerment can be performed is lacking. Nevertheless, Thomas and Tymon (1993) empowerment model provides building blocks – a practical guide that have relevance on the shop floor, wherein tasks are defined in terms of activities and the rationale for those activities emphasized.

There is also a suggestion that empowerment implies "free of rule books". However, this supposition is not significantly upheld in the oilfield services industry where compliance to standards and specifications is key. The question then to be asked is emphasized by the one asked by Harris (2006) which asks;

"How do you enable people to take the initiative to make needed creative decisions in their work with the equally important discipline needed to follow standard procedures?"

Although the answer in Harris (2006) view isn't obvious, according to Stuart (2008), empowerment efforts can offer greater freedom within constraints, setting boundaries to define what people can or cannot do to prevent organizations from becoming anarchy.

Also, there seems to be an assumption that empowered personnel will follow the guidelines and procedures laid down, however this may not be the case. Moyle et al. (2005) study on the role of individual differences in employee adoption of quality orientation indicates that the consideration for differences amongst individuals leads to greater acceptance of organizational change initiatives by employees. But McGregor (1960) maintains that people have an innate desire to take pride in what they do. Hence, according to Hunter (2012), by creating an environment where people can take pride in what they do, the ability of the organization to perform is optimized. Bartunek and Spreitzer (2006) argue that although some studies such as that done by Spreitzer (2007a), Kraimer et al. (1999) and Ergeneli et al. (2007) have modelled empowerment as four different dimensions or components, the potency of empowerment is in the interaction of the components rather than individually.

2.3. Part Three – Process

> *If you can't describe what you are doing as a process, you don't know what you are doing.*
>
> *(Edwards, W. Deming)*

2.3.1. Overview of Process

Process refers to a group of related or interacting tasks and activities that transforms specific inputs to outputs (IBS-America, 2012). According to Suarez (1992), it is also any set of conditions or set of causes, that work together to produce a given result….usually a blending of machines, methods, materials and people (p.9). Deming (1986) highlighted the importance of process stating that 94% of all failures in a business organization are the result of systems, suggesting that if companies need to rid themselves of 94% of their failures they should focus on establishing effective processes.

Perhaps this may explain why many companies have initiated and implemented programmes such as LEAN, Six Sigma and other robust practical process- improvement initiatives to a point of obsession. There is a process or procedure for virtually every activity being carried out in the oilfield service industry, a situation Antonsen et al. (2008) labels as "jungle of procedures". These numerous and overly developed processes for which absolute compliance is advocated, in addition to its development and implementation being expensive, have stripped companies of their most valuable assets which is drive and passion in its people. Incidentally, these valuable assets are elements critical in the improvement and sustenance of quality.

According to Power (2012), although processes trump people in terms of getting work done right, it will beat a good person every time it is bad or broken. If procedures are insufficient, ambiguous, impractical, contradictory, ineffective, or otherwise unworkable, then non-conformance or violation may be more attributable to a weakness in the procedures themselves than to the individual. It becomes a system-induced violation. Procedural violations in highly regulated companies, according to Patankar et al. (2005), are inevitable because there are just too many procedures and it is practically impossible to ensure consistent compliance (p.31). According to Antonsen et al. (2008), the sheer number of procedures may even be a barrier towards their use.

Most of the processes in place are derived from either industry recommended practice (IRP) and (or) identified best practices that have proved efficient, safe and cost effective over the years.

An industry recommended practice (IRP) is a set of best practices and guidelines compiled by knowledgeable and experienced industry and government personnel intended to provide the operator or user with advice regarding the topic considered (ENFORM, 2008). These practices which are designed to establish suitable operating practices especially in emergent aspects of operations are often reviewed, updated or revised in response to customer requirement, research findings, public or regulator concern, individual incidents, new standards and guidelines, pressure from competition, environmental conditions or technological innovation. The rationale for adopting a new best practice usually varies from practice to practice and from company to company and as such, there is no consensus on both formal and informal procedures for establishing best practices.

Within a few companies however, there exist within a body of subject matter experts in specific fields or experienced personnel that validate and authorize the inclusion of certain aspects of any best practice identified in the field. When these recommendations are validated and included in the process or procedure, they are circulated as a formal enforceable process to the rest of the personnel. Thus, because of the existence of this formal body within organizations that validate, authorize and disseminate best practices (by way of email or alerts) to the rest of the group, only a few best practices are being made available for consultations, comment or discussed in workshop settings before being adopted. This poses a potential challenge for the ground staff who are supposed to work with these processes, if not properly communicated. Poorly managed process contributes to project delays with its measurable non-productive time, midstream reallocation of resources, and reprioritization of other initiatives and activities. On the other hand, good processes that are well executed enable organizations to more effectively utilize resources, leverage automation and track key performance metrics and results for continuous process improvement.

As the oil and gas industry continually develops best practices focused primarily on industry activities associated with exploration and production (Aecom, 2009), two reasons have been given for the sheer increase in number of procedures. The two factors as cited by Antonsen et al. (2008) include:

1. Complexity of work - This leads to an attempt to make the procedures as realistic as possible, thus resulting in an ever-increasing number of procedures.
2. Institutional mechanisms - In the aftermath of accidents and incidents, regulatory authorities usually demand some kind of action to be taken to prevent similar incidents happening again. Creating new procedures or amending existing ones is a common and highly visible way of satisfying such demands. Consequently, procedures have a tendency to become increasingly restrictive (Reason et al., 1995), in Antonsen et al. (2008).

2.3.2. Elements of process reliability in the industry

Process design – This is a huge part of process reliability and efficiency. Standard work instruction (SWI) and operational checklist have long been used as process tools in the industry to address workflow associated with job design, pre-job, job execution and post-job. These tools are also used to address job variation and risk level, hence requiring standardization and prompt deployment of changes in instruction. Although workflow, task, standard work instruction and checklist may be presented as different documents in a process, they are all related. A workflow represents a simplified and standardized representation of how real work is performed and consists of a sequence of chronological tasks. Each task represents a unit of work to be accomplished by a single individual or a small team. The sequential operational steps to be performed in a task can then be further specified in a standard work instruction. Some standard work instructions can contain checkpoints, which represent a special type of operational step critical to the successful outcome of the task. These check points are finally complied for a given work flow.

Standard work instructions are predominantly used by workers with a basic proficiency level in a given skill within the competency system and contain all steps for a given task. The tasks need to be executed in the stated order for successful task completion. Standard work instructions are performed by reading and then doing the operational step, referred to as the "Read – Do" technique. This technique directs the worker step-by-step, highlighting any key points that will make or break the task, injure the worker and make the work easier to do. However, a more detailed standard work instruction can be used regardless of the proficiency level.

Checklists are developed for workers that maintain a proficiency level of intermediate, advanced or expert in a given skill and contain only the few critical checkpoints for a given workflow that must be executed every time if the job is to be successful. Checklists are performed by doing the task and then confirming completion, referred to as the "Do -Confirm" technique. This means that the worker first executes the job (i.e. all the steps) from memory as per the training received; ideally this training is based on standard work instructions. Then at a predefined standard work execution point during the job, the work is paused and the checklist is executed in the form of 'challenge and response', where the challenge question is read by a person that did not do the work to be reviewed. This technique ensures that the team member involved in doing the work provides positive confirmation that the critical steps have been accomplished. Hence, checklists act as reminders of only the most critical and important steps that even a highly skilled professional could miss occasionally when only relying on memory.

Procedural adherence **–**The oilfield service industry by nature of its business requires highly structured operating procedures and policies to be profitable. This is in line with Lawler (1994), Ishikawa (1986) and Feigenbaum (1983) stance that procedures not only ensure conformance to specification, it also aids in identification of existing or potential problems which is critical in unpredictable environment.

However, at the core of process reliability are the behaviour and actions of the employee. This behavioural aspect or procedural adherence is reinforced by the 'do-confirm' concept where a second user confirms each critical step taken. According to Hancock and Parasuraman (2002), procedures should embody a standardized level of base-line knowledge and represent the best practice for task completion while providing specific instructions and steps to be taken.

Competence **–** The competence of the user handling the process is very important. In evaluating competence, the oilfield service industry has historically used training and years of experience as a measure of competence. However, the post Macondo requirements demand that leaders in the industry develop models and systematic approach that ensures development of skills and competence independent of years of experience.

2.3.4. Challenges to Implementation of Processes

1. Employee level of education and training - Given the low academic level of mostly the maintenance community and the contractual nature of most of the jobs, formal training continues to be an ongoing challenge making on the job training the main component of career development (Pahl, 2007).

2. Fear of complexity - The perception that processes are encumbering with varied levels of complexities can prevent its adoption. However breaking down critical components or individual complex problem can reduce this fear, which is usually profound where changes are not communicated.

3. Use of non-standard terms - The use of non-standard phraseology can pose a problem in the implementation of processes leading to failure in detecting error. This is particularly a concern for multinational companies where different nations and languages are represented. The use of the right terminology reduces the chance of misunderstandings when confirming the status of each critical operational step.

The development and implementation of a process takes away any excuse of ignorance on the part of the user, making them accountable for right or wrong judgment. It allows end user feedback and suggestions for improvement in real time making identification and address of bottlenecks a lot easier. This is particularly important as risk awareness and reduction is a huge part of industry recommended processes (Petroleum Services Association of Canada, 2013). According to Nanda (2016) process improvement has become synonymous with quality improvement due to the growing realization that companies develop products and provide services by executing business processes.

2.4. Part Four - Equipment maintenance

> "As maintenance is heavily reliant on human activity, maintenance quality is largely dependent on the performance of maintenance staff."

2.4.1. Overview of Equipment Maintenances

Maintenance, according to Papavinasam (2013), is a key activity in all sector of the oil and gas industry (p. 801) and has for the most past been seen as a necessary evil to be minimized rather than a cost to be optimized (Blann, 2014). However, this perception is changing (Kutucuoglu et al., 2001), being acknowledged as a major contributor to the performance and profitability of business organizations (Tsang et al., 1999, Tsang, 1998) and is routinely carried out (Papavinasam, 2013).

In theory, maintenance refers to the combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function (EN 13306: 2001, 2001). According to Pintelon and Parodi-Herz (2008), maintenance is defined as a combination of all the technical and associated management and (or) administrative activities required to keep equipment, installations and other physical assets in the desired operating condition or to restore them to this condition. These activities, according to Pintelon and Parodi-Herz (2008), are usually embedded in a business context (Figure 2.4) to which it has to contribute implying therefore that maintenance function needs to cope with multiple forces and requirements within and outside of the walls of the organization.

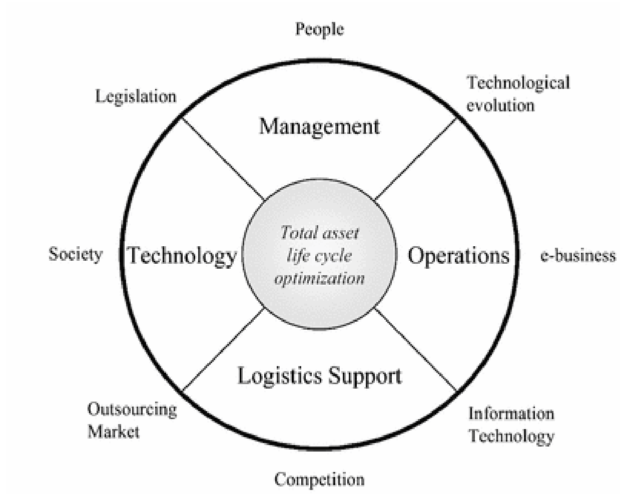


Figure 2.4: Maintenance in context

Source: Pintelon and Parodi-Herz (2008)

According to Papavinasam (2013), maintenance activities often times require additional resources than is usually present within an organization. Hence to ingrain the maintenance practice in a complex and dynamic context, a maintenance management is required which is focused on total asset lifecycle optimization.

The oil and gas industry, to which the oilfield services organizations belong, is an asset-intensive industry with capital assets ranging from drilling rigs, offshore platforms and wells in the upstream segment, to pipelines, LNG terminals, and refineries in the midstream and downstream segments. These assets, which are usually costly to design, build, operate, and maintain are mostly characterized and impacted by maintenance. Nevertheless, the extent and nature of the impact depend upon the type of activities carried out.

Maintenance tasks are complex; comprising a blend of management, technology, operations and logistics support elements (Figure 2.4). Although influenced by individual, job and organizational factors, maintenance is heavily reliant on human activity hence its quality is largely subject to the performance of maintenance staff. There are four fundamental reasons underlying equipment failure, and these are enumerated below.

1. Failure caused by unmanaged deterioration - causes of this kind of failure include erosion, fatigue, oxidation, and corrosion, lack of lubrication, dirt ingress, and wear and tear; build up of dirt or debris, equipment disassembly.

2. Failure due to change in the way the equipment is used is often caused by lack of unambiguous operating procedure, poor management of change, lack of focused, organized training, and poor procedural adherence to management of change.

3. Failure can occur if equipment is unfit for purpose **-** typical root causes of unfitness include lack of involvement of operations in design phase, mistakes in procurement, sub-standard installation, and unforeseen ergonomic problems.

4. Failure caused by human error - typical root causes include misplaced good intention, risk taking, mistakes, deliberate violations and training errors.

The right equipment for the right job is necessary for smooth operation. Hmida et al. (2013) stress that in some instances, no special inspection, maintenance or health check is carried out on equipment returning from jobs, predisposing them for lower reliability. According to Hmida et al. (2013), the problem with current maintenance programmes in oilfield service companies today is that they are not designed to handle the high volume of complex equipment. The bulk of the maintenance performed at the organization level is routine and preventive maintenance and are usually performed by in-house staff. Even worse is the fact that a high percentage of all maintenance time, cost and energy are spent on reactive activities (Strawn, 2015). In the ABC's of

Failure (Ledet, 2008), it was concluded that approximately 84% of the defects that lead to failures are in fact created randomly by care-less work practices (i.e. inadequate care) throughout the entire organization while 4% of the defects are due to aging of equipment, and 12% of the defects due to basic wear and tear. According to Ledet (2008), out of the three operating domains (Figure 2.5) affected by human behaviour with respect to maintenance, precision domain is the place to attain to.

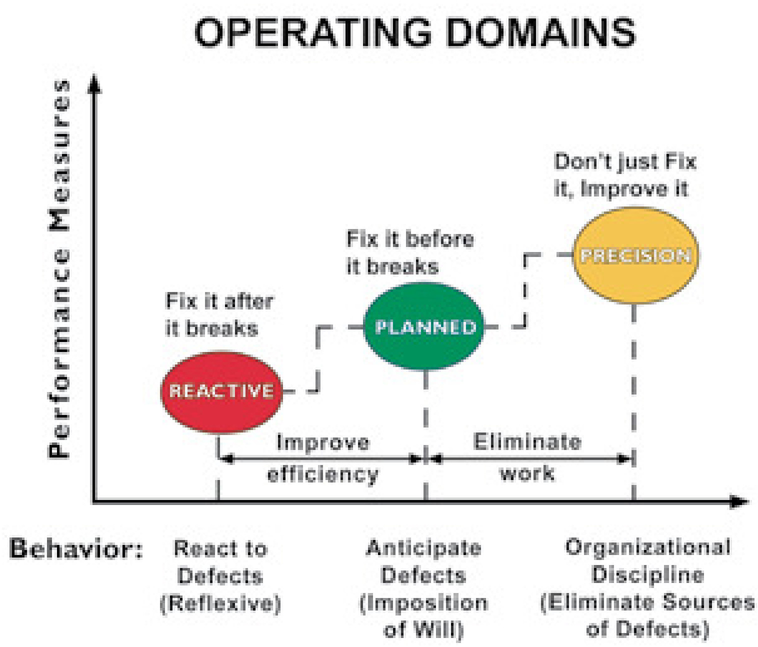


Figure 2.5: Maintenance operating Domains
Source: Ledet (2008)

The philosophy of the precision domain is "Don't just fix it, improve it" mirroring the quality culture philosophy.

2.4.2. Development of maintenance philosophies

According to Kumar and Kapil (2013), the development of maintenance philosophy spans over three generation.

Generation 1 – This is the period before the Second World War.

Here, the background and characteristics of equipment were simple, over designed and easy to repair. The maintenance technique and philosophy for this generation is characterized as basic and routine maintenance, reactive breakdown service of 'fix it when it's broke'.

Generation 2 – This second generation was at the time of the Second World War. The background and characteristics of equipment was more complex together with greater dependence of industry on machinery and significant maintenance cost relative to other operating cost. The maintenance technique and philosophy for this generation is planned preventive maintenance.

Generation 3 – This is the 1980's generation characterized by continued growth in plant complexity and accelerated use of automation. Equipment downtime in this generation is very costly, with rising demand for standard of product or service quality and tightening legislation. The maintenance technique and philosophy for this generation is condition monitoring, hazard studies, failure modes and effect analysis, reliability centred maintenance and computer aided maintenance management, multi skilled individual and team employee, and emphasis on reliability, availability, proactive and strategic maintenance.

2.4.3. Role and benefits of equipment maintenance

Maintenance role and benefits can either be in its function or strategic contribution. Functionally, Kelly (1989) states that the objective of maintenance is to achieve the agreed output level and operating pattern at a minimum resource cost within the constraints of the system condition and safety. According to

Visser and Pretorius (2003), maintenance is partly responsible for the technical systems' safety and for ensuring that the plant remains in good condition. Strategically, maintenance helps maximize the profitability of a business over its life. Equipment in perfect operating condition not only averts interruptions to production but also helps keep production costs low, keeps product quality high, maintains safe working conditions, and avoids delays in product delivery (Sookdeo et al., 2006, Levitt, 2009) as cited in Pun and Sookdeob (2010).

In spite of these roles, the contribution of effective maintenance activities can only be maximized if the maintenance team or personnel involved is dedicated, committed, unflagging, and focused on achieving good maintenance practices. According to Hmida et al. (2013), the primary reasons for equipment performance failure in the oilfield service industry are the lack of proper maintenance, ineffective or non-existent quality control procedures and the scarcity of skilled maintenance technicians.

2.4.4. Categories of Equipment Maintenance

At the activity level, maintenance could be classified into reactive and proactive. Reactive maintenance occurs when an unscheduled breakdown necessitates a repair intervention. This mode of maintenance is typically more expensive and time consuming than planned maintenance, in terms of organizing and executing. It disrupts smooth flow of work sequencing as materials/equipment and manpower are shifted to accommodate emerging work fronts. Proactive maintenance, on the other hand, results in high reliability. This maintenance category is used to prevent damages or impending failure. Preventive and predictive works are collectively categorized under proactive maintenance.

The choice of the strategy to use usually depends on the most appropriate way to reduce risk. Reactive strategy is used mainly when risk and consequences are negligible. However, when the consequences translate to safety, production or even environmental threats, proactive strategy is adopted.

Typical equipment maintenance plans as identified by Hmida et al. (2013) in their study include:

1. Run-to-failure maintenance work – typically carried out on non-critical equipment. This type of maintenance has been used for a long time and its cost is high because of unpredicted downtime and machine damages.

2. Fixed time or planned maintenance – Fixed maintenance occurs periodically on a fixed time interval thereby preventing failures. This is similar to Tai et al. (2009)'s routine maintenance carried out at regular intervals involving minor tasks.

3. Condition based maintenance (CBM) – This is a powerful tool for improving reliability and downtime reduction (Tai et al., 2009). According to Hmida et al. (2013), CBM relies on condition monitoring to detect early signs of failure onset since major failures do not just happen without warning. CBM has strong impact on NPT and maintenance action can be immediate (diagnostics) or planned (prognostics).

4. Preventative maintenance (PM) – This involves both fixed and planned-scheduled maintenance of plant as fallout of periodic inspection before failure actually occurs, thereby protecting the plant from failure and potentially extending its life. The challenge with PM is that it only prevents "wear out" failures; there is risk of replacing good parts; PM amplifies maintenance-induced failures and has heavy impact on asset availability.

5. Design out maintenance – According to Shikari and Sadiwala (2004) this type of maintenance is "design oriented" and particularly targeted at "eliminating cause of maintenance," resolving recurring equipment problems. They stressed that cost and interface challenges necessitate making a choice between the cost of redesign and cost of recurring maintenance.

Despite the multiple maintenance types that exist, equipment do not get restored to as-new state due to maintenance errors or poor quality workmanship (Davidson, 1994) or due to design or manufacturing inconsistencies (Patankar and Taylor, 2004).

2.4.5. Key maintenance performance indicator

Maintenance performance measures (MPM) have been the focus of many research endeavours (De Groote, 1995, Tsang, 1998, Tsang et al., 1999, Visser and Pretorius, 2003, Wreman, 2005, Campbell and Reyes-Picknell, 2006, Parida and Kumar, 2006, Alsyouf, 2006) with varied key performance indicators developed.

Maintenance performance measurement is defined as the multidisciplinary process of measuring and justifying the value created by maintenance investments, and meeting the organization's stockholders' requirements, viewed strategically from the overall business perspective (Parida and Chattopadhyay, 2007). MPM allows companies to understand the value created by maintenance, to re-evaluate and revise their maintenance policies and techniques, to justify investment in new trends and techniques, to revise resource allocations, and to understand the effects of maintenance on other functions and on the stakeholders, as well as on health and safety (Parida and Kumar, 2006).

Key performance indicator used for equipment maintenance varies from organization to organization depending on the kind of product and services rendered. For the oilfield service industry typical maintenance KPI has an element of time. Although maintenance is very important in keeping KPI such as availability as high as possible, no amount of maintenance can raise the capability of an asset if design or installation is not correct.

In an overview of the state of maintenance, its current problems and the need for adequate metrics for its quantification, Mata et al. (2008) noted that maintenance is seen in the industry as a necessary evil, an expense or loss, which the organization must incur to keep its production process operative. Because of this, the priorities of a company do not typically focus on maintaining assets, but on the production that they represent. Nevertheless, according to Kumar et al. (2013), maintenance of large-investment equipment, which was once thought to be a necessary evil, is now considered key to improving the cost effectiveness of an operation, creating additional value by delivering better and more innovative services to customers.

Globally, one way the industry has adopted to forestall NPT caused by equipment failure is by the use of root cause analysis (Hubbard et al., 2010). This is a flexible, fit-for-purpose process performed by an assigned team of specialists. Initiated by Shell in 2006, this process has enjoyed global adoption especially at the North Sea region/areas, which serve as a standard of safety and quality for the industry. Several root cause failure analysis methodologies exist, such as 5-Whys, Fishbone (Ishikawa) Diagram, Apollo, and Systematic Cause Analysis Technique (SCAT). Each method has pros and cons, and the appropriateness of the method will depend on the nature of the problem. Although flexible, the objective is two-fold, an immediate objective and a long-term objective. The immediate objective is to address the tool that failed while the long-term objective would be to prevent future occurrence and performance improvement. The root cause of the failure could be identified as a lack of system control or a lack of a documented procedure or process. The analysis of these failures could also indicate quality management system weaknesses and identify operational system weaknesses. This process has yielded a lot of success for organizations such as Shell, which can be seen in the Figure 2.6 with a reduction in NPT in its Gulf of Mexico (GOM) operation. As shown in Figure 2.6, during the three years of the initiative, failure frequency had reduced 60% from five to less than two failures a month.

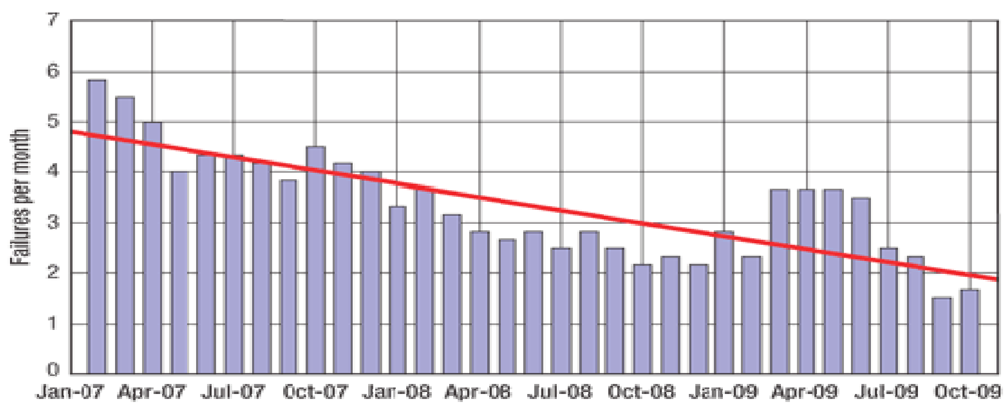


Figure 2.6: Frequency of equipment failure in Shell GOM drilling operation

Source:Hubbard et al. (2010)

The methodology has enabled sharing of alerts and corrective action for tool failures worldwide preventing repeat failures.

2.4.6. Challenges with Equipment Maintenance

Although equipment maintenance has long been associated with improved operations, there are challenges experienced in this regard. According to Papavinasam (2013), the reliability of equipment maintenance depends on availability of facilities and personnel, hence the challenges enumerated are focused on these two factors.

1. Lack of a dedicated maintenance team – For a long time, the workers themselves, with no defined parameters, carried out maintenance. Equipment maintenance was more loosely organized, and there was no haste for the machinery or tools to be operational again. However, in recent times, organizations have established formal career paths, giving opportunity to the junior staff to assume new and challenging roles. While these measures may alleviate the current challenge, organizations need to re-examine practices towards hiring/recruiting, training, certifying, and promoting the maintenance population.

2. Personnel technical expertise and competence – There is a low level of operator knowledge and involvement in maintenance together with low technical expertise of the maintenance staff. As maintenance tasks are often very varied, the experience and skills of maintenance staff are important factors in ensuring high standards of performance. This is even more so in organizations that adopt a multi-skilling strategy. Furthermore defining and verifying the competence necessary to perform a maintenance task is not so easy. Competence depends upon both the capability of an individual and the appropriateness of that capability to a specific job, which may include some novel aspect not covered in the basic training. Individuals involved in complex tasks, such as some fault diagnostics, are even more difficult to assess for competency. Competency therefore needs to be considered in the context of the range of jobs and not in absolute terms.

3. Outsourcing and contracting alignment – When some of

the maintenance activities are to be performed by third party service providers, the contractors sometimes are not aware of the organizations processes and their role in successful delivery of those processes.

4. Lack of maintenance management system – Lack of a well-defined or real systematic approach to equipment maintenance will not only affect production but create difficulty in identifying any recurring failures (Wilson, 2012).

5. Staff turnover and retention - key competencies, skills, knowledge and experiences are usually lost with personnel exit or transfer within an organization. Furthermore, when there is no effective handover process, there is disproportionate impairment of operational capabilities.

6. Conflict of interest - The degree of independence of personnel involved in key integrity assurance roles is usually not sufficient. Personnel performing assurance roles should be part of a stand-alone function or of some other function suitably independent of the operational line.

7. Insufficient resource allocation - Maintenance activities require resources such as people, time, tools and equipment, and procedures. Where insufficient allocation of these resource exist, maintenance staff may alter their work practices (by taking shortcuts) to overcome resource difficulties in the genuine belief that such behaviour will benefit the organization and that it is expected of them. Hence, although insufficient resources may not necessarily stop the maintenance activity, its impact is usually evident in poor maintenance, which may directly or indirectly impact the bottom line. Furthermore, the fact that the task is eventually completed makes the detection of resource issues difficult. Inadequate resources may make it more difficult to undertake a task or make the task performance less reliable.

8. Lack of maintenance policy - The need for a maintenance policy is often neglected. Even where there is such a policy, it is often produced without consideration of other business objectives. Problems frequently arise when the responsibilities for maintenance are uncertain or where the maintenance policy is not compatible with the organization's business plan. In these cases, it is common for the maintenance function to have difficulties in securing adequate resources. For any maintenance policy to serve a real purpose, it is necessary that staff feel they have ownership of the policy and share the views of the organization. Maintenance policy enables prioritization of maintenance activities alongside competing business demands.

9. Management of Change - It is important to ensure that the impact of any change on maintenance is not ignored and, where possible, allow for the opportunity for introducing improvements in maintenance performance. Some changes particularly affecting maintenance include the introduction of new technology, procedural change, increased use of multi-skilling, and reduced staffing levels.

10. Maintenance procedures - The level of detail required in the procedures should recognize staff competency, the complexity of the task and how frequently it is carried out bearing in mind that the reasons often cited for staff not following maintenance procedures are that they are perceived to be inaccurate, out-of-date, impractical, too time consuming, or that they do not describe the 'best' way of carrying out the work. Maintenance staff also needs access to the comprehensive set of maintenance procedures providing information on the required tasks.

Table 2.2 presents some of the factors that have been shown to improve maintenance activities.

Table 2.2: Maintenance activity improvement factors

Factors	Citation
Maintenance management system	Cholasuke et al. (2004); Mostafa (2004),Mjema and Mweta (2003), Fernandez et al. (2003), Sherwin (2000)
Availability of spare parts	Cholasuke et al. (2004), Mostafa (2004), Reason and Hobbs (2003), Al-Muhaisen and Santarisi (2002),
Maintenance method	Mostafa (2004), Fernands et al (2003), Coetzee (2000)
Maintenance vision and mission	Mostafa (2004), Hoffman (2002),
Planning and Scheduling	Cholasuke et al. (2004), Mostafa (2004), Al-Muhaisen and Santarisi (2002), Campbell (1995)
Documentation	Mostafa (2004), Reason and Hobbs (2003), Al-Muhaisen and Santarisi (2002)
Organizational structure and Policy	Mostafa (2004), Al-Muhaisen and Santarisi (2002), Wilson (1999)
Knowledge and experience	Cholasuke et al. (2004), Reason and Hobbs (2003), Nakajima (1989)
Availability of resources (Tools and facilities)	Mostafa (2004), Cholasuke et al. (2004), Reason and Hobbs (2003), Al-Muhaisen and Santarisi (2002)
Finance (Budget)	Mostafa (2004), Cholasuke et al. (2004), Al-Muhaisen and Santarisi (2002), Kelly (1997)
Empowerment programmes	Cholasuke et al.(2004), Mostafa (2004), Al-Muhaisen and Santarisi (2002), Kelly (1997), Nakajima (1989)

2.4.7. Equipment maintenance literature critiqued

There is a consensus in all the literature reviewed that maintenance is a strategic component of business performance. But there is a common perception that maintenance is all about equipment, which according to Papavinasam (2013) is a misconception. According to Papavinasam (2013), maintenance is not associated with equipment or infrastructure alone but with at least five interdependent entities of equipment, workforce, data, communication and associated activities (p.801). With 84% of failures attributed to careless work practices, it implies therefore that careful work habits are required to overturn the statistics, regardless of maintenance type.

Furthermore, there is a push to shift maintenance role perspective from that of "fix things when they break" to that of keeping them running and increasing reliability levels, of elimination of defects before they are even generated or without repair (Strawn, 2015). According to Blann (2014),when things break down, maintenance has failed! Hence, the maintenance job is to maintain it so that it never breaks down. This is the principle of total productive maintenance and requires a culture change to attain. To make this culture change of careful habits, Ledet (2008) proposes three things; an urgent business need, an empowered workforce and a strong leadership. In other words, reliability is generated by the behaviour of the people.

In assessing personnel competency, there is always an assumption that maintenance staffs are competent merely because the maintenance work was satisfactorily completed. This measure does not necessarily address whether the work was carried out to the specified procedures. Conversely, evidence of poor maintenance work does not always imply incompetence.

Nevertheless, the best organizations view maintenance as requiring competent, dedicated professional staff and economics of a good maintenance programme show up in increased utilization of equipment.

This study, however, does not look to explore which maintenance strategy is better than the other but to examine the significance of effective maintenance in general, regardless of type, to quality operations.

2.5. Part Five - Operational Efficiency

Efficiency is doing better what is already being done.
(Drucker F. Peter)

2.5.1. Overview of Operational Efficiency

Operational excellence ranked the second most global challenge faced by organizations in 2013, behind human capital, according to a chief executive officer (CEO) challenge survey conducted by The Conference Board (2013). This annual survey covering Asia, Europe, United States, China and India, and targeted at service, manufacturing and finance industries, showed employee engagement, which is fostered by employee empowerment (Evans, 2010), as one of the top five strategies employed by CEO to tackle the operational excellence challenge.

The efficiency of a service organization is usually dependent on well-managed operations (Bateson and Hoffman, 1999) and not just about harnessing and directing people’s energy. Efficiency refers to savings in time, money and efforts (people and resources) expended to accomplish a task (Nanda, 2016) while still maintaining the elements of success in the service.

These operational costs are directly or indirectly affected by government policies, business environment and level of competition. For drilling companies for example, labour, materials and equipment escalates cost to drilling and equipping a well to about twice the rig day rate (Ark et al., 2013). Time is of great essence in the oilfield industry and service quality is a great enabler of operational efficiency as it helps identify non-value added costs. Time spent in doing things right the first time assures avoidance of rework for that operation. Unfortunately, in the Macondo incident for example, this was not the case. It is reported by Kaiser (2009) that "engineering excellence was not a top priority (*for the engineering team at BP)* because in their view, if they got it wrong, they could always take remedial action" (p.31). This attitude, in a high process industry such as the oil and gas, is usually a recipe for disaster.

Although it could be argued that achieving operational quality service may be costly in itself but the operational expenditure savings that result from doing it right the first time can only be fully appreciated when disasters happen. As the Chartered quality Institute, UK motto puts it 'when quality works we take it for granted. It is only when it fails, that we truly realize its value'. Thus the benefit of quality is usually felt when it is absent. So why is operational efficiency critical in oil and gas industry?

According to Ayala et al. (2006), the remote locations in which oil and gas field operators operate often presents logistical challenges and security concerns. The industry continues to face pressure to reduce risk, even with new strides into challenging ventures like ultra deep water exploration, drilling in the Arctic, exploitation of shale gas in populated onshore locations and floating liquefied natural gas. This shift to frontier sources, according to McCreery et al. (2013), accompanies a changing competitive landscape that requires oil and gas players to become more nimble and to compete in new roles.

The rise of the national oil companies (NOCs) and the loss of access to easy reserves are pushing international oil companies (IOCs) and independents to improve their technological and operational skills as well as their capabilities for working with governments and other partners. The NOCs' rising expectations and their interest in new kinds of partnerships create huge opportunities for oil field service companies—but they too must develop their expertise and capabilities to manage more risk and project complexity while providing integrated field operations, above and below the surface. These changes get complicated with increased expectations and demands from stakeholders like communities, shareholders, regulators and NGOs. All these have caused industry executives to seek definition and delivery of operational efficiency at these new frontiers of no precedence.

Supervision ratio presents another concern, rising from a ratio of 1:1 ratio 20 years ago to 1:5 currently (McCreery et al. 2013). This is impacted by decreasing average in experience levels, shortage of technical talent and capability, resulting in increased cost of employees and services even further, a situation which is compounded with increasing activity levels causing sector inflation (McCreery et al., 2013).

All these pressures faced by the oil and gas companies contribute to the increasing need and value of operational efficiency and (or) excellence. According to 2006 Schlumberger oilfield review, "increased efficiencies in equipment, processes and personnel allow operators to economically continue producing from mature fields and to develop new fields in remote locations" (p.79).

2.5.2. Operational efficiency and operational quality

In an open market, firms need to deliver quality services and products that are of right value, so as to attract and retain a superior market share. This necessitates efforts to improve operational efficiency across the firms value chain (Hopkins, 2012) while retaining the elements of success vis-a-vis cost.

In the oilfield services industry, citing example in the drilling context, cost pressures are ubiquitous. For the Gulf of Mexico drilling organization, regular benchmarking is performed against other drilling companies all over the world. This inevitably puts cost reduction pressure on companies to be seen as belonging to the enviable top quartile. For the BP team, this translated to cultivation of an "every dollar counts culture" with the implication that cost control could go to extraordinary lengths (Hopkins, 2012, p.85). According to Hopkins (2012), "the cost and time pressures that BP had created for its engineers potentially undermined their commitment to engineering excellence" (p.87).

Fundamentally, efficiency entails delivery of better services and products with fewer resources. This implies maximization of productivity and elimination of wastes, which directly reduces operational costs, improves quality and ultimately increases a firm's customer attraction and retention. An organization can enhance efficiency by either keeping inputs constant and increasing output or keeping output fixed and reducing input. However, Pietersen (2010) argue that although there is temptation for firms to compete on basis of efficiency alone, it should be recognized that competing on cost helps keep a firm in the game while delivering of superb value helps win the game.

Quality methodologies, by definition, force an organization to assess their ways of business deliverables: from the products they offer, to how they market and sell them, to what processes and systems they rely on to deliver these products, and, ultimately, to how the members gauge the service they receive from the organization. This involves a shift from the classic business and operational management model to a process management model, providing increased process clarity, consistency, and ownership, as well as improved oversight and general control (Shaffle et al., 2011). According to Edwards et al. (2011), achieving greater efficiency is a consequence of a deliberate pursuit of quality excellence. However, although quality improvement may be efficient in the long-term, it might reduce operational efficiency in the short-term because the cost of an improvement effort is immediate, while the corresponding benefits are generally delayed (Nanda, 2016). Therefore any decrease in near-term operational efficiency, could, due to lack of foresight, result in reluctance and resistance to adopt change, a challenge shared also by operational quality improvement effort.

2.5.3. Critical elements of operational efficiency

According to Shaffle et al. (2011), "design of processes (how work gets done, by whom, when, and why) is at the core of operational efficiency—the seamless flow of work through the organization drives the cost associated with that service and product. Well-designed processes require fewer resources because all areas of waste, redundancy, rework, poor handoff, and failure have been identified and removed. Additionally, good process design takes into account the 'voice of the member' and ensures that those processes can meet member requirements and expectations. A well-designed process will ensure that all steps required to fulfil the request (whether internal or completed by a vendor) can consistently meet that expectation.

Ultimately, well-designed processes create the foundation for an organizationally efficient company" (p.3). Initiatives need to be complementary and harmonious with existing system and procedures, to stimulate efficiency improvement in an organization. Shaffle et al. (2011) highlight that "operational efficiency will only be marginally enhanced through changes made solely to the machine or medium component *since* automation does not replace human work; it merely changes its nature" (p.24). The authors maintain that quality methodologies help organizations effectively address the critical drivers of operational efficiency by enabling them to ensure that the technology they purchase meets internal and external requirements, allowing for seamless integration, by ensuring that processes are designed to minimize cost while consistently meeting member needs.

2.5.4. Efficiency Literature critiqued

People are a key factor of operational excellence in firms, regardless of size and location, although overlooked or downplayed in some occasion. For an organization to achieve operational excellence, it needs to develop a culture that encourages its staff to act 'right' always. However, most focus in the industry has been mostly on one aspect of operational excellence, which is safety. But operational efficiency is the capability of an organization to deliver products or services to its customers in the most cost-effective manner possible while still ensuring the high quality of its products, service and support.

Simplifying and streamlining the core processes in a firm can position it to be more responsive to changing market environment hence demonstrating operating efficiency. Furthermore, cost reduction resulting from minimizing redundancy, waste and rework, while leveraging on its best technology, work processes and manpower, helps a firm to achieve operating efficiencies, deliver better profit margins and be more competitive. Notwithstanding efforts aimed at optimizing operational efficiency and effectiveness should not solely be on cost cutting that aims only at lower cost with possible sacrifice of service and (or) product quality. This approach may produce short-term gains but may jeopardize long-term profitability and growth potentials, as customers may be lost to higher quality service and product providers.

2.6. The Research theoretical perspective

The purpose of this section is to represent the concept that emerged from the literature review and set them into a framework. A research framework is a representation of the understanding of theories and concepts relevant to the research topic. As such, the basic conceptual model (Figure 2.7) is derived from the understanding that personnel empowerment, effective process and equipment maintenance are the three main factors that impact operational quality in the oilfield service environment although at varying capacities.

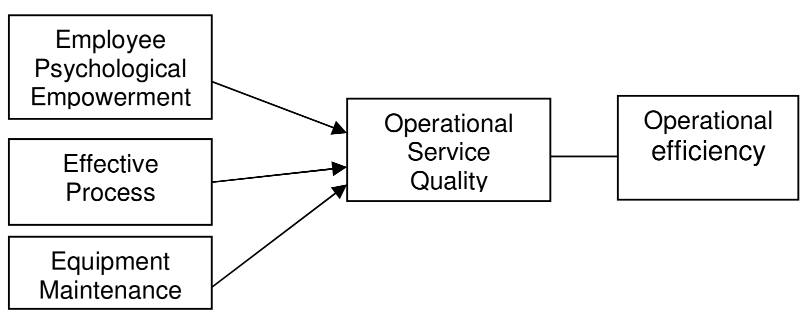


Figure 2.7: Basic conceptual model

Figure 2.8 therefore captures the theoretical representation of the research framework understanding.

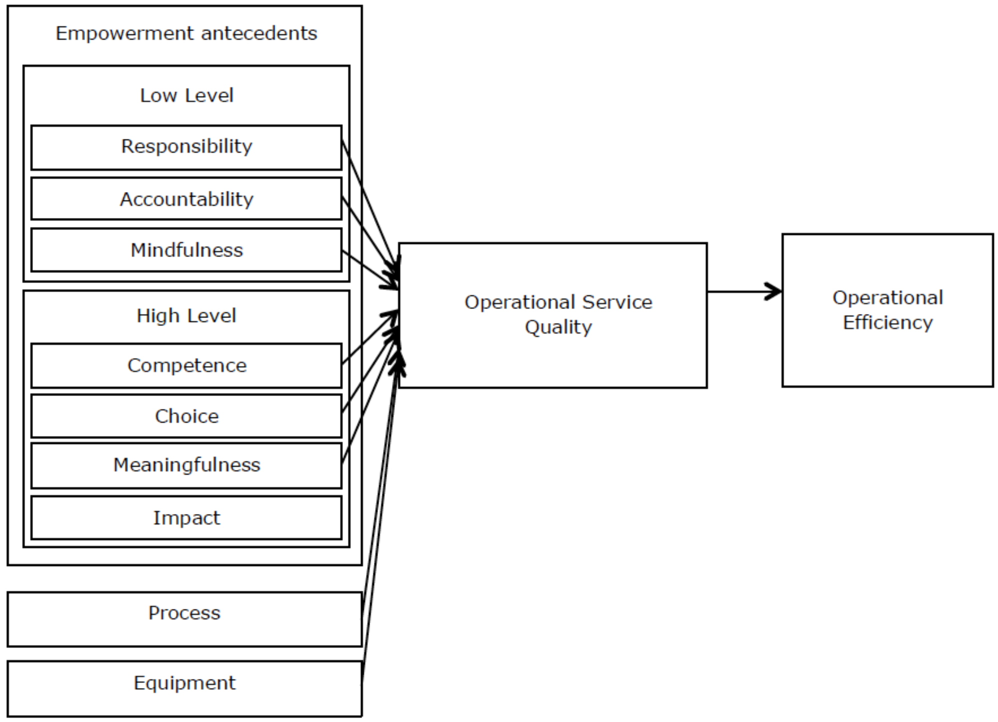


Figure 2.8: Theoretical framework

The approach and the justification for the methodology adopted in this study are detailed in chapter three.

2.7. Development of Hypothesis

According to Sekaran (2003 p.103) a hypothesis is "a logically conjectured relationship between two or more variables expressed in the form of a testable statement". From the proposed framework shown in Figure 2.7, a set of four hypotheses of interest was developed to measure the empirical aspect of the study.

The first hypothesis makes prediction that:

H_1 = The high level antecedents of empowerment have a high positive association with employee psychological empowerment and are significantly strong dimensions of empowerment.

The high level antecedents, which are the foremost, identified and recognized aspects of psychological empowerment in literature by Thomas and Velthouse (1990) are competence, choice, meaningfulness and impact.

Competence in the oilfield service industry has many dimensions to it including proven experience, technical training, portfolio-based assessment not limited to but includes witness testimonies, naturally occurring task related evidence, discipline-specific questions, online technical training, job appraisals and safety related training. According to Thomas and Velthouse (1990), competence is "the degree to which a person can perform task activities skilfully when he or she tries" (p.672). Accelerated skill development therefore shortens the time to autonomy, enabling the transformation of both the inexperienced new hire and less-confident experienced personnel into confident and effective contributors.

Choice has been shown to increase an individual's sense of personal control (Taylor and Brown, 1988) and feelings of intrinsic motivation (Deci and Ryan, 1985). According to de Charms (1968), "when a man perceives his behaviour as stemming from his own choice, he will cherish that behaviour and its results; when he perceives his behaviour as stemming from the dictates of external forces, that behaviour and its results, although identical in other respects to behaviour of his own choosing, will be devalued'' (p. 273). Choice, in the view of Chua and Iyengar (2006), allows for the expression of personal preferences, control, and internal attributes, in turn allowing one to establish oneself as a volitional agent and to fulfil the goal of being independent" (p.47). However, choice becomes a challenge in a process-oriented industry where almost every operation is regulated and commands total compliance.

Meaning involves a comparison between the requirements of a work role and an individual's beliefs and values such that the individual perceives the task to be of value to him/herself (Sigler and Pearson, 2000). According to Wrzesniewski and Dutton (2001) individuals play an active role in creating the meaning of their work, through job crafting, that is, through small changes they make in task, relational and cognitive boundaries of the work.

Impact is recognized as the influence level an individual wields on strategic, and operational objectives in a work place (Ashforth, 1989).

A support of hypothesis H_1 would mean that these four antecedents would bring the much-expected result of empowering the employee since having a stronger influence on employee psychological empowerment.

The second hypothesis makes prediction that:

H_2= The low level antecedents of empowerment have positive association with employee psychological empowerment.

This hypothesis suggests that the low level antecedents of responsibility, accountability and mindfulness have an association with employee empowerment, but on their own are not sufficient to achieve empowerment outside of the boost from high-level antecedents.

According to Ormsby (2012), "mindfulness is a mental orientation that continually evaluates the environment as opposed to mindlessness where a simple assessment leads to choosing a plan that is continued until the plan runs its course" (p. 4). This mental state of mindfulness, according to Weick and Sutcliffe (2005) in studying high reliability organization, tracks small failures, resists oversimplification, remains sensitive to the operations in practice, maintains the capability for resilience, and takes advantage of changes in who has expertise.” According to Weick and Sutcliffe (2005), being mindful is “paying attention in a different way…It means to start “paying attention to things that disconfirm, are unpleasant, feel uncertain, seem possible, are implicit and are contested” (p. 30). Mindfulness helps the individual think conceptually or in abstract terms thereby enhancing the individuals’ situational awareness. To foster mindfulness at an organizational level, organizations must create an environment where people are not afraid to speak up. This enabling environment mirrors Senge (1990) environment of organizational learning where “people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together” (p .3).

According to Scharmer (2010), the quality of our attention shapes the quality of our results. Furthermore, Ndubisi (2012a) strongly suggests that approaching work with a mindfulness bias can present a more sustainable solution to organizations on reliability and quality front, when compared to approaches like ISO 9000 and Six Sigma. This suggestion is in line with Ormsby (2012)’s causal chain of mindfulness (Figure 2.9) expressed without the notion of meditation.

Figure 2.9: Causal chain of mindfulness
Source: Ormsby (2012)

Accountability, a practice unavoidably embedded in every aspect of work life, has often been used as mechanism for informal or formal sanctions (kopell, 2005) or blame or punishment hence the avoidance of it by employees. This implies that avoidance of accountability by employees is due to fear of being punished for their actions. According to Yukl and Becker (2006), accountability is the perceived potential of being evaluated by someone and being answerable for decisions or action. This may be linked with 'principle of bureaucratic accountability' - a system that rewards success and punishes failure (Frink and Ferris, 1998, p.1260). Despite that, there still remains support for the inclusion of some possibility of sanctions in the constitutive element of accountability as well as in its definition (Strom, 2003, Mulgan, 2003, kopell, 2005). Supporters of the inclusion of some possibility of sanctions indicate that holding people accountable for their results has very positive effects such as greater accuracy of work, better response to role obligations, more vigilant problem solving, better decision making, more cooperation with co-workers, and higher team satisfaction. In other words accountability, which is further defined as owned commitment, helps build operational discipline making a big difference in business outcomes.

Role/task responsibility is defined as a product of social roles that one acquires or chooses to accept (Bergsteiner and Avery, 2011), implying duties and obligations arising from the proper performance of the role and from group membership. Although most operations in oilfield service industry requires team effort to get done, responsibility, according to Vego (2009 p. 68), "remains singular and individual and cannot be shared", arguing that teams (shared responsibility), delegation (devolution) and dispersion, dilute role/task responsibility; an issue Bovens (1998) sees as 'problem of many hands". Nevertheless, role/task responsibility has limits (Bergsteiner and Avery, 2011, p. 34) and it is critical that the limits of individual responsibility be delineated as clearly and specific as possible (Vego, 2009).

A support of hypothesis, H_2, therefore would mean that although these antecedents are important, they on their own are not sufficient to psychologically empower employees in the oilfield service environment and hence may not yield the intended result for conviction and commitment to operational service quality.

The third hypothesis makes prediction as shown below:

H_3 = Employee psychological empowerment, process and equipment maintenance have a positive association with operational service quality.

This hypothesis prediction suggests that success in operations within the oilfield services industry is contingent upon having all three elements—the right personnel, performing the right process, and on the right equipment.

Process is referred to as "a set of interrelated/interacting activities that transforms inputs into outputs" (IBS America, 2012). According to Rahman and Bullock (2005), "attention to process, product and information technology may yield quality improvements, but ultimately it is people that make quality happen" (p.75). But Levitt (2006) argues that looking for solution in an activity executor derives from the attitude legacy where improved service is viewed as dependent on attitude and skills improvement of the activity executor himself. According to Levitt (2006), "thinking in humanistic rather than technocratic terms ensures that the service sector will be forever inefficient and that our satisfactions will be forever marginal". However, Shaffle et al. (2011) highlights that "operational efficiency will only be marginally enhanced through changes made solely to the machine or medium component *since* automation does not replace human work; it merely changes its nature" (p.24). Reduced process variation results in better output uniformity as well as reduced rework and waste (Forza and Filippini, 1998) due to the timely identification and rectification of quality problems in the production process (Ahire and Dreyfus, 2000). Regular preventative equipment maintenance enhances product quality by improving machine reliability and reducing interruptions in production (Ahire and Dreyfus, 2000).

A support of hypothesis H_3 would therefore mean that all three factors are significant in explaining operational quality albeit in different capacity.

The fourth hypothesis makes a prediction that:

H_4= Operational service quality has a positive association with operational service efficiency.

Quality methodologies, according to Shaffle et al. (2011), help organizations effectively address the critical drivers of operational efficiency ensuring that they meet internal and external requirements.

A support of hypothesis H_4 will imply that for an organization to achieve operational excellence, it needs to develop a culture that encourages its staff to act 'right' always.

The summary of the hypotheses developed is as shown:

H_1 The high level antecedents of empowerment have a high positive association with employee psychological empowerment and are significantly strong dimensions of empowerment.

H_2 The low level antecedents of empowerment have positive association with employee psychological empowerment.

H_3 Employee psychological empowerment, process and equipment maintenance have a positive association with operational service quality.

H_4 Operational service quality has a positive association with operational service efficiency.

2.8. Chapter Summary

The key observation made with all the five parts reviewed in this chapter, without deviating from the main, is the highlighted unique role employees' play in an organization. Perhaps because of their creative minds, employees are viewed as the greatest asset an organization could have. According to Zirek (2011), no matter the endeavour, quality improvement relies on individuals or teams – their innovations, skills, knowledge, motivation and contributions which must be integrated and aligned with organization's strategy. Employee psychological empowerment has been at the core of strategic change in organizations. By understanding and isolating the antecedents of employee psychological empowerment relevant in the environment of study, it will enable a focused attention by organizations for optimum benefit.

This chapter provides a foundation for investigating the criticality of the three factors and a development of an empowerment focus in the environment of study. The concepts, which emerged from the literature review, were considered in the development of the theoretical framework to guide select the suitable approach to achieve the research aim and object. Methodology adopted is discussed in the next chapter.

CHAPTER 3 RESEARCH METHODOLOGY

> "…Research methodologies are merely tools,
> instruments to be used to facilitate understanding"
> -(Hollnagel, 2012)

3.0. Aim

The aim of this chapter is to show evidence of recognized and documented research methodologies, highlighting the strengths, weaknesses and synergies, especially with respect to applicability to this study. Furthermore, justification for the research methodology adopted for this study is discussed. The reference study design and context, and how the study was implemented to meet objectives are also shown so that other researchers may replicate the study in the future, although according to Jick (1979), "replicating a mixed-methods package […] is a nearly impossible task" (p.609). Lastly, the ethical research considerations made for this study is discussed.

3.1. Introduction

Research, according to Gerrish and Lacey (2010), is "an attempt to increase the sum of what is known, usually referred to as a body of knowledge, by the discovery of new facts or relationships through a process of systematic scientific enquiry, the research process" (p.4). Broadly categorized into primary and secondary research (Clarke, 2005), it is also defined by Macleod Clark and Hockey (1989) as a "diligent systematic enquiry to validate and refine existing knowledge and generate new knowledge" (p.2). According to Gill and Johnson (2002), there has to be a fit between research methodology and research questions. Thus the most appropriate approach depends on many variables and may indeed involve a compromise between various options (Gill and

Johnson, 2002). Tranfield et al. (2003) indicate that the choice of research approach is often influenced by resource availability, implying that any research method chosen will, to a large degree, depend on the ease of implementing that method.

3.2. Research Workflow

The rigour exercised in the overall study methodology is shown in Figure 3.0. According to Moisander and Valtonen (2006), the reliability criteria in non-quantitative work can be satisfied via two ways. Firstly, by making the research process transparent through describing the research strategy and data analysis methods in a sufficiently detailed manner in the research report. Secondly, by paying attention to 'theoretical transparency' through making explicit the theoretical stance from which the interpretation takes place and showing how this produces particular interpretations and excludes others.

From the research workflow diagram (Figure 3.0), the round-cornered boxes represent processes or stages of the research study whereas the squares represent the flow of information. The main objective of the diagram is to depict inputs and outputs of the study stages in order to better understand how they are integrated. Three main inputs into the interview process are

- The research context
- The research questions and objectives
- The potentially important variables and relationships identified from past research works.

Output from this stage is used to generate an interview protocol and the pattern of variables/relationships for further study during the expert multiple interviews. The objective of the multiple expert interviews was to describe the situation, identify the critical factors and the challenges.

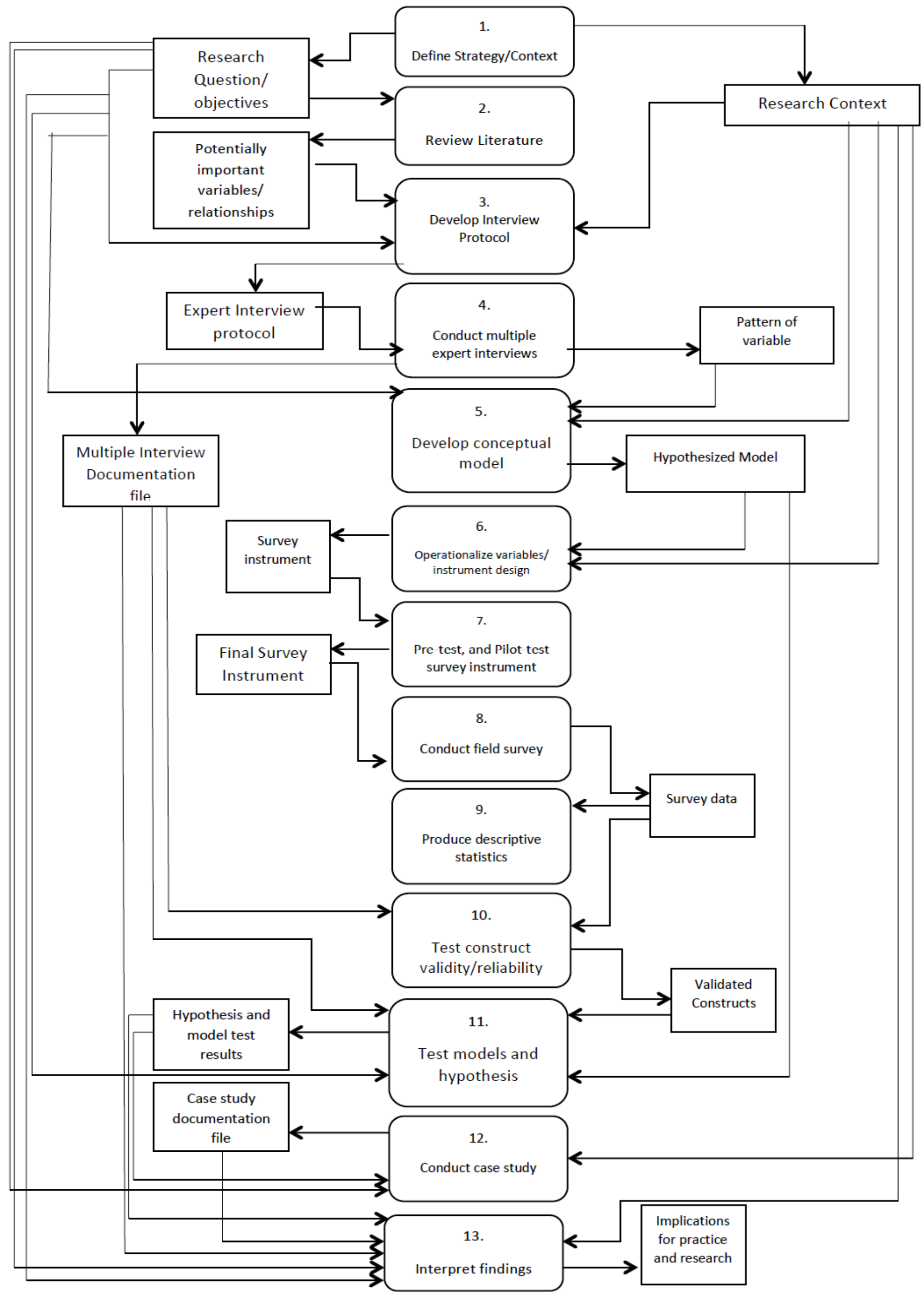


Figure 3.0: Overall study methodology

Note that the interview guide used comprises of a list of topics, or discussion points that serve as reminders of what needs to be covered in the interview. According to Kumar (2014), interview protocol need not necessarily be set up as questions.

The developed interview guidelines (Kvale, 1996, Gillham, 2005, Kumar, 2014) which were adhered to throughout the interview process served to increase the reliability of the data (Kvale and Brinkmann, 2009, Cutler, 2004), providing the readers with a structured guide on how the study was conducted (Yin, 1994). According to Golafshani (2003), reliability is referred to as the researcher's responsibility for ensuring the research process is logical, traceable and documented.

The primary unit of analysis of the reference study, operational quality service critical factors, was identified prior to the interview. The dependent variable in the multiple expert interviews was operational quality, however the independent variables of interest were those factors identified from literature to have a major influence on the operational quality and consequently, operational efficiency of the organization. These variables were compared with the pattern of variable derived from the multiple expert interviews representing therefore the predicted pattern.

The two main outputs of the interview phase are: (1) a pattern of variables, and (2) the multiple subject matter expert interview documentation file. The primary purpose of the pattern of variables extracted from properties and dimensions noted during the interview is to serve as the main input to development of the conceptual model to be tested in the survey (stage 6). The main purpose of the multiple interview documentation file is to supply rich detailed background on the subject, to aid in interpretation (stage 13) of results from statistical analysis of the survey data (hypothesis and model testing - stage 11) and to serve as a further test of validity/reliability (stage 10) through comparison of survey results with case study findings (triangulation). Other stages in which the interview is useful include: stage 7 - pilot testing of the survey instruments, and stages 11 and 12. It is important to note that the case study was conducted after the survey rather than before the survey, as it did not contribute to the model building exercise.

Since no one best approach exists by which any research is conducted (Burns and Grove, 2005), recognized research methods and the selected methodology used in applying this workflow is discussed in section 3.3. According to Loseke (2013), methodology refers to the study of, and justification for, the methods used to conduct the research.

3.3. Recognized Research Methods

According to Clarke (2005), qualitative and quantitative methods are two main research methodologies that are utilized in business and technical researches. While the former is numerically oriented, focusing on measurable aspects, the later is descriptive in nature, identifying key variables that often are foundations for further research. These two classification of the methods, although distinct in functions, have been viewed to be complementary (Thomas, 2003), necessitating the third methodological approach called the mixed method (Thomas, 2003). According to Greene (2007), mixed methods "actively invites us to participate in dialogue about multiple ways of seeing and hearing, multiple ways of making sense of the social world, and multiple standpoints on what is important and to be valued and cherished" (p. 20). A review of the three recognized methods- qualitative, quantitative and mixed method approach- is detailed in the following section to evaluate its relevance to the research needs.

3.3.1. Qualitative Research Approach

According to Denzin and Lincoln (2000), a "complex, interconnected family of terms, concepts and assumptions surround the term qualitative research" (p.2). For instance, Cassell and Symon (1994) describe qualitative research as a research with a focus on "interpretation rather than quantification; an emphasis on subjectivity rather than objectivity; flexibility in the process of conducting research; an orientation towards process rather than outcome; a concern with context—regarding behaviour and situation as inextricably linked in forming experience; and finally, an explicit recognition of the impact of the research process on the research situation" (p.7).

This description by Cassell and Symon (1994) would arguably appeal more to critics of qualitative research. However, Silverman (2006b) contends that most arguments on the superiority of quantitative research over qualitative research or vice-versa are unbalanced and could be seen from different perspectives.

The merits of qualitative versus quantitative research methods have been highlighted by works of many authors (Neuman, 1991, Glassner and Moreno, 1989, Ragin, 1987, Downey and Ireland, 1983, Light and Pillemer, 1982, Merton and Coleman, 1979). Portrayed as effective in many ways, qualitative research approach is aimed at identifying key variables in particular situation that may be useful in framing questions to explore further by qualitative means or other methods of enquiry.

According to Barbour (2008), the research method helps in the understanding of illogical behaviours, allowing access to the embattled process by focusing on the context of people's everyday lives, where such decisions are made and enacted. Furthermore, the effect of any changes on daily procedures and interactions can be examined using qualitative research, thereby illuminating existing processes or uncovering intended and unintended consequences of processes (Barbour, 2013). It provides an understanding of how and why things are, and is particularly suited for studying context (Yin, 2014) although Silverman (2006b) observes that unfortunately, “contextual sensitivity is not always shown by qualitative researchers” (p.44).

In spite of the qualitative research merits, the approach has been criticised as being unscientific, exploratory, or subjective. The criticisms are backed by the fact that the methodology is heavily dependent on the skills of the researcher and is prone to influence by researcher's personal biases which is not easily done in quantitative approach where one is faced with numerical data that could be expressed in mathematical expressions that can be extrapolated. To get around this challenge of proving reliability, Kirk and Miler (1986) recommend a clear documentation of methodology used to aid in the duplication of the study.

Furthermore, critics of qualitative research have highlighted that maintaining, assessing, and demonstrating rigour is difficult and the volume of data makes analysis and interpretation time consuming. In relation to subjectivity, the unavoidable presence of the researcher during data gathering is claimed to influence respondent responses. However, Denzin and Lincoln (2000) posits that it is only in the course of doing field research that one can find out which (research) questions can reasonably be asked and it is only at the end that the researcher will know which questions can be answered by a study.

Another criticism of qualitative approach is the issue of ‘apt illustration’ (Narayan, 2005), or ‘anecdotalism’ (Silverman, 2006b) which questions the validity, or truth of the research. For this reason, Moser (2002) in Narayan (2005), advices it is critically important, where sufficient data exist, to further develop the methodology so as to provide quantified data.

According to Silverman (2006b), qualitative research have been portrayed to downplay or avoid statistical techniques which Grahame (1999) views as a negative definition. To proceed beyond such negative definition, in practice, many qualitative researchers use open-ended or in-depth interviews (Baert et al., 2010, p. 203).

Another challenge faced in qualitative research is boundary of disclosures. The issue of anonymity and confidentiality more often than not constitute limitations when presenting findings as confidentiality through the process of anonymity cannot be assured nor guaranteed. The concept of barriers to participation in interviews tend to surface when the individual feels they do not wish to disclose what might come back to haunt them.

Despite this scenarios, qualitative methods, according to Lueger (2000), are sensitive enough to allow the detailed analysis of change, hence, very appropriate for research questions focusing on organizational processes, outcomes, and understanding of both individual and group experiences of work (p.1).

3.3.2. Quantitative Research Approach

Quantitative research approach has not only received criticisms from academia but also from the general public whose scepticism owes to the selective use of figures to say just about anything, including lies (Silverman, 2006b). However, this concern has been dismissed as constituting only a blip (Silverman, 2006b).

There is also an assumption that quantitative research always involves studying statistics or conducting a survey. However, other range of options exist such as the five main methods of quantitative social science research identified by Bryman (1988). The five options include social survey (random samples measured variables), experiment (experimental stimulus and control group not exposed to stimulus), official statistics (analysis of previously collected data), structured observation (observations recorded on predetermined schedule) and content analysis (predetermined categories used in counts).

Furthermore, quantitative techniques rely on numerical data collection, and usually adopt analytical methods such as statistical correlation, often in relation to hypothesis testing (Walliman, 2006). According to Baert et al. (2010), quantitative researchers are rightly concerned to establish correlations between variables but Silverman (2006a) sees this as a "reluctance to move from statements of correlation, to causal statements" (p.38). Nevertheless, quantitative research method remains a favourite for scientists. According to Worrall (2000), this favouritism to quantitative method in the discipline lies in the 'predictive advantage' of the method. However, Tewksbury (2009) argues that prediction is not necessarily a quantitative task nor does it require statistical analysis to perform. According to Tewksbury (2009), prediction is based on theoretical grounds, and the testing of theoretical concepts, propositions and relationships that are qualitatively developed.

The purpose of quantitative research is to make cause and effect statements where experiment is needed to manipulate or treat variables. However, according to Gable (1994), survey research is inflexible to discoveries made during data collection. Once the work is underway, there is little one can do upon realizing that some crucial item was omitted from the questionnaire, or upon discovering that a question is ambiguous or is being misunderstood by respondents. Thus, traditional survey research usually serves as a methodology of verification rather than discovery. Nevertheless, a pre-test of the survey instrument helps minimize ambiguity and ensure understanding.

Another challenge faced with quantitative approach is that it does not allow the researcher to gather more details about the subject without running the risk of having a long questionnaire, which puts respondents off. According to Cassell and Symon (1994), quantitative methods are only able to "assess that a change has occurred over time but cannot say how (what processes were involved) or why (in terms of circumstances and stakeholders)"(p.5). Zikmund (2003) suggest a less than 6-page brief and only essential questions as a general rule for questionnaires, however this is sometimes not very practical.

The distinction between qualitative and quantitative research approach expressed in Table 3.0 does not suggest one approach better than the other but shows a path of understanding.

Table 3.0: Qualitative and Quantitative research distinct comparative feature

	Qualitative Approach	**Quantitative approach**
Research Focus (Merriam, 2009, Vanderstoep and Johnston, 2009)	Quality – Nature / Essence	Quantity – How much, how many
Purpose and Design Characteristic (Merriam, 2009, Vanderstoep and Johnston, 2009)	Descriptive, Flexible, emergent, evolving	Structure, Prediction
Orientation (Vanderstoep and Johnston, 2009, Walliman, 2006)	Industrial approach to theories	Deductive approach to theories
Philosophical roots (Merriam, 2009)	Constructivism, Symbolic interaction, Phenomenology	Realism, logical empiricism, positivism
Epistemology (Walliman, 2006)	Positivism rejected	Positivism embraced
Associated phases (Merriam, 2009)	Constructive, fieldwork, naturalistic, grounded, ethnographic	Experimental, empirical, Statistical
Ontology (Walliman, 2006)	Constructionist	Objectivist
Investigation goal (Merriam, 2009)	Discovery, understanding, meaning, hypothesis generation, description	Test of hypothesis, Confirmation, control, description, prediction
Primary mode of analysis (Merriam, 2009)	Inductive, comparison	Deductive, Statistical analysis
Sample (Merriam, 2009)	Small, purposeful, non-random, theoretical	Large, representative, random
Data collection (Merriam, 2009)	Observations, document reviews, interviews	Survey, questionnaires, tests
Findings (Vanderstoep and Johnston, 2009)	Comprehensive, descriptive, holistic, realistic	Precise, numerical, cumulative, replication

3.3.3. Mixed Method Research Approach

Mixed method research is defined as a research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches and methods in a single study or programme of enquiry (Teddlie and Tashakkori, 2009) while addressing range of both confirmatory and exploratory questions (Creswell, 2009). This research approach is premised on the belief that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone. According to Silverman (2010), research questions can be answered most satisfactorily by combining quantitative and qualitative studies.

Mixed methods use both deductive and inductive logic in a distinctive sequence, moving from grounded results (observations, facts) through inductive reference to general references, then from those general inferences (or theory, conceptual framework, model) through deductive inference to predictions to the particular (a priori hypotheses) (Teddlie and Tashakkori, 2009).

Table 3.1 presents some definitional focus of some authors in defining and describing mixed method while Table 3.2 is a comparison of qualitative, quantitative and mixed method research approach distinctive features. The comparative features above shows that mixed methods research provides strengths that offset the weaknesses of both quantitative and qualitative research. With mixed method, researchers may utilize all of the tools of data collection available thereby enabling understanding of complex issues such as personnel empowerment and answering research questions that cannot be satisfactorily answered by qualitative or quantitative approaches alone.

Table 3.1: Authors and their definitional focus of mixed methods

Author (s), year and definition	Definitional focus
Burns and Grove (2005) "Include at least one quantitative method (designed to collect numbers) and one qualitative method (designed to collect words), where neither type of method is inherently linked to any particular inquiry paradigm. (p. 256)	Methods Philosophy
Tashakkori and Teddlie (1998) "The combination of "qualitative and quantitative approaches in the methodology of a study" (p. ix)	Methodology
Greene et al. (1989) "The type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purposes of breadth and depth of understanding and corroboration. (p. 123)	Qualitative and quantitative research Purpose
Tashakkori and Creswell (2007) "Research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a programme of inquiry. (p.4)	Qualitative and quantitative research Methods
Johnson et al. (2007) "Actively invites us to participate in dialogue about multiple ways of seeing and hearing, multiple ways of making sense of the social world, and multiple standpoints on what is important and to be valued and cherished (p. 20)	Multiple ways of seeing, hearing, and making sense of the social world
Creswell and Plano Clark (2007) "A research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis and the mixture of qualitative and quantitative approaches in many phases of the research process. As a method, it focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies (p.5)	Methods Philosophy

Table 3.2: Qualitative, Quantitative and mixed method research distinct comparative features

	Qualitative approach	**Quantitative approach**	**Mixed method approach**
Research purpose (Teddlie and Tashakkori, 2009)	Often Exploratory and confirmatory	Often Confirmatory then exploratory	Confirmatory plus exploratory
Paradigm (Teddlie and Tashakkori, 2009, Creswell, 2009)	Constructivism	Post-positivism Positivism	Pragmatism, transformative
Inquiry Strategy (Creswell, 2009, Teddlie and Tashakkori, 2009)	Narrative, case study, grounded theory, ethnography	Experiments and non-experimental design	Sequential, Concurrent, Transformative
Role of theory (Teddlie and Tashakkori, 2009)	Grounded theory, Inductive logic	Rooted in conceptual framework, deductive model	Inductive and deductive logic
Sampling (Teddlie and Tashakkori, 2009)	Purposive	Probability	Purposive, probability and mixed
Data collection method (Creswell, 2009)	Observations, document reviews, interviews, text and image analysis, open ended questions, emerging methods	Survey, questionnaires, pre-determined method, instrument base questions, observation plus performance data, statistical analysis and interpretation	Both pre-determined and emerging method, Both open and closed ended questions, multiple forms of data collection, Statistical and text analysis,
Data form (Teddlie and Tashakkori, 2009)	Typically narrative	Typically numeric	Both narrative and numeric

Thus based on the highlighted comparisons above together with the focus of this study, a mixed method approach was chosen and a justification for its choice is discussed below.

3.4. Justification for choice of Mixed Method

At the core of this study is a practically pertinent problem to which a solution will be directly relevant to decision makers in the oilfield service industry as suggested by Labro and Tuomela (2003, p. 416). The frequent quality lapses in the industry amidst all initiatives are a concern to management hence an effective attempt to resolution or containment of these lapses will go a long way in maintaining operational efficiency.

According to Allan (1998) research on quality management, which is the focus of this study, is shamelessly eclectic with no one single paradigm sufficient enough to capture all the parameters covered in the research questions (p.s4). For this study, and included in the parameters of interest, is a mixture of both physical (equipment and process) and social (empowerment) factors. These mixed parameters mirror the two divisions of research paradigm – positivism and interpretivism (Noronha, 2002) which appear to be in opposition (Lee 1991, p.350).

According to Lee (1991), the positivist paradigm makes the claim that its methods, the methods of natural science, are the only truly scientific ones, whereas the interpretive paradigm makes the counterclaim that the study of people and their institutions calls for methods that are altogether foreign to those of natural science (p.350). The interpretive approach, according to Lee (1991), requires that the researcher must collect facts and data describing not only the purely objective, publicly observable aspects of human behaviour, but also the subjective meaning this behaviour has for the human subjects themselves (p.347).

Given the different assumptions of positivist and interpretivist paradigm, both require different instruments and procedures suited for data gathering, which mixed method addresses. Adopting a mixed method approach will enable elaboration or expansion on the findings of one method with another (Creswell, 2009), as well as provide theoretical and methodological rigour for practical relevance (Steger et al., 2012).

3.4.1. Challenges with mixed method approach

Despite its value, conducting mixed methods research is not easy. Some of the reported challenges with mixed method include:

1. Time and resources: Collecting and analyzing both quantitative and qualitative data is extremely time consuming and requires a lot of resources. It is even more frustrating when the industry is an environment where most data are classified as private and confidential, hence very few or limited public data is available. Furthermore, where data do exist (e.g. incident record in world offshore accident database), it still does not form a good basis for statistical analysis (Baker and McCafferty, 2005). The reason, according to Baker and McCafferty (2005), is that reporting is voluntary and the content of the database is based on the information collected and compiled. In order to get around this challenge, an observer-participatory approach was used to allow for time to gather data.
2. Researcher training: investigators are often trained in only one form of inquiry (quantitative or qualitative), and mixed methods require that they know both forms of data. Attendance and completion of a self sponsored 3-day structured training organized by the Malaysian postgraduate workshop series helped to address this challenge.
3. Mixed method approach complicates the procedures of

research and requires clear presentation if the reader is to be able to sort out the different procedures. A workflow diagram represented in section 3.2 was used to address this challenge.

3.4.2. Related studies with mixed method Approach

Studies undertaken using mixed methods are usually difficult to locate in literature due to recent use of the term mixed methods in titles or in methods' discussions (Walliman, 2001) or an exclusion as listed keyword in many journals. However, Creswell (2009) developed a short list of terms used to search for mixed methods studies within electronic databases and journal archives. These terms include

- Mixed method* (where * is a wildcard that will allow hits for "mixed method," "mixed methods," and "mixed methodology")
- Quantitative AND qualitative (where AND is a logic operator requiring both words to limit and restrict the search)
- Multi-method, and
- Survey AND interview.

A few related example studies, generated using this term, that illustrate the relevance of mixed method study include Creswell (2013) evaluation of empowerment impacts of participatory budgeting in Brazil wherein the parameters for the questionnaire-based survey was developed using mixed method. A combination of narrative and statistical data was used in final analysis.

In the measurement and analysis of empowerment in Jamaica, Brook and Holland (2009) used two instruments to generate data; a community score card completed by focus groups, which produced numeric ratings as well as a narrative explanation of the ratings, and secondly a rapid assessment peer interviews of individual young people in the communities (ethnographic research). The aim was to use scorecard findings to feed into the design of peer research questions so that the latter could analyze the structural factors underpinning the scores. The combination and merging of the findings of both tools at the analysis stage yielded significant policy relevant information about empowerment in a timely and cost effective way.

In another study evaluating interpretation programme implemented in the community, Farmer and Knapp (2008) used a mixed methods approach to uncover and explore both the immediate impacts of the experience, as well as the long-term information. The method which entailed pre- and post questionnaires, in-depth and informal interviewing, observations, provided an opportunity to explore interpretation programmes from varying points of view, enabling researchers to gather data that offered breadth in discerning the outcomes of the programme.

Other examples of researches in which mixed methods have been adopted include Bennett (2006) use of mixed-methods in understanding the processes of empowerment and social inclusion in Nepal; Woolcock and Gibson (2005) ethnographic research which employed quantitative methods to select sites for qualitative module in examining the mechanisms by which conflict is initiated, intensified, and resolved (or not resolved) in different contexts in Indonesia.

Mixed method research has also found application in oilfield service organizations with some of the companies utilizing them for quality assessments. Citing an example of a standard quality management gap analysis performed by Schlumberger oilfield services, this analysis combined the qualitative data based on each participant's experience, knowledge and perception of how the quality system is being performed. Each participant's perceptions are recorded with an answer of Yes (score: 1), No (score:0), or N/A (Not Applicable or Do not Know; No score). A numeric score is assigned to each question answered, with the quantitative results gathered in a gap-spider plot. The findings of result, compared to set quality management system controls and audit results, together with the requirements stipulated in the quality management system document of the company enable identification of weak system implementation.

As this study has chosen a mixed method study, the research design which is the arrangement of conditions for the collection and analysis of data (Phillips, 1971), in a manner that aims to combine relevance to the research purpose with economy in procedure (Selltiz et al., 1976) is discussed as follows. It is a plan for the collection, measurement and analysis of which can be differentiated along a variety of dimensions (Emory, 1980) as shown in table 3.3 below.

Table 3.3: Dimensions of Research Designs

Exploratory	Explanatory
Case	Statistical
Field	Laboratory vs. Simulation
Cross-sectional	Longitudinal
Observational	Survey
Experimental	Ex post facto
Descriptive	Causal

Source - Emory (1980)

The data collection will involve a semi-structured qualitative interview for exploratory purpose, followed by quantitative survey analysed using structural equation modelling (SEM) to enable generalization of result. Finally, three case company studies are used to validate and enrich findings. The justification for data collection and analysis methods adopted are discussed below in section 3.5.

3.5. Data Collection Method and Justification

The success of any measurement system is based on the method used for data collection (Kumar et al, 2013). According to Hentschel (1999), data can either be quantitative (numbers) or qualitative (text), just as the methods used to collect those data can also be quantitative (for example, large representative surveys) or qualitative (such as interviews or observation). This distinction gives rise to a simple 2x2 matrix (Figure 3.1) showing the forms of data and data collection itself.

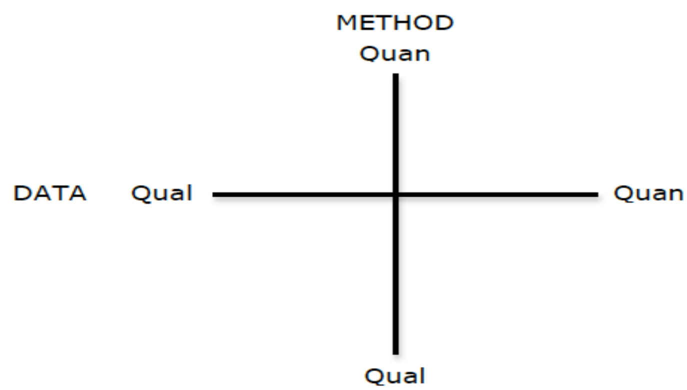


Figure 3.1: Types of data and method
Source: Hentschel (1999)

The upper right or lower left quadrants, according to Narayan (2005), are most often the adopted quadrants for researches that are evaluative, comparative or development in nature. Yin (1984) specify three conditions to consider in deciding which strategy to use for research method. These conditions are

- Type of research question posed
- Investigator control over actual behavioural events
- Degree of focus on contemporary unlike historical events.

Table 3.4 below summaries the relevant situations for different research strategies.

Table 3.4: Relevant situation for different research strategies

Strategy	Form of research question	Control of behavioural events required?	Focus on contemporary events?
Experiment	How, Why?	Yes	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/No
Survey	Who, what, where, how many, how much?	No	Yes
Case study	How, why?	No	Yes
History	How, why?	No	No

Source: Yin (1999)

This study utilized a survey and case study strategy. The use of case companies in this study allowed for integrated explanation, interpretations and descriptions of situations and contexts, to provide clearer view of the phenomenon under study. Table 3.5 below shows the relative strengths of both survey and case study methods.

Table 3.5: Relative strengths of survey and case study methods

	Survey	Case Study
Controllability	Medium	Low
Deduct-ability	Medium	Low
Repeatability	Medium	Low
Generalizability	High	Low
Discoverability (Explorability)	Medium	High
Represent-ability (Potential model complexity)	Medium	High

Source: Gable (1994)

The survey strategy comprising of qualitative (interview) and quantitative (questionnaire) data collection was used for this study with the qualitative interview as an initial source of information. Categorized into structured, semi-structured and unstructured interview (Saunders et al., 2000, Sekaran, 2003); standardized and non-standardized interview (Healey, 1991, Healey and Rawlinson, 1994); and respondent and informant interviews (Powney and Watts, 1987), all based on level of formality and structure, each type of interview serves a different purpose (Table 3.6).

Table 3.6: Interview type versus purpose

Interview type	**Exploratory**	**Descriptive**	**Explanatory**
Structured		More frequent	Less frequent
Semi Structured	Less frequent		More frequent
In-depth	More frequent		

Source: Saunders et al., (2000)

A semi-structured interview was selected for this study. The data collection method– semi structured interview, questionnaire survey and case study- used in this study is discussed as follows.

3.5.1. Qualitative – semi structured interview

A semi-structured interview was conducted with subject matter experts or what Narayan (2005) calls 'key-informant interview'. This is an extended one-on-one exchange with someone who is a leader or unique in some way that is relevant to the study. This was aimed at understanding the area of interest to this study from the subject's point of view and to unfold meaning from respondent's experiences to scientific explanations. According to Easton (1993, p.9) it is difficult to explore management issues of any subtlety using typical questionnaire-based approach as they are often superficial with great ambiguity and generally lack operational definition of the terms used in the surveys. Thus, data collection from the individual or unit directly responsible for managing a certain operation of interest is essential.

The four conditions as proposed by Saunders et al., (2000) on which the choice of semi-structured interview for this study was based include:

1. Nature of Research – Semi structured interview as with in-depth and non-standardized interviews are useful in an exploratory research, providing the means and opportunity to describe, explain and build on interviewees' responses in order to formulate and build theories, a process described by Corbin and Strauss (2008) as theory grounded from data.

2. Establishment of personal interests – Semi-structured interview stimulates interest and sparks new ideas (Saunders et al., 2000) hence advantageous in studies of this nature where perspectives of subject matter experts are sought. According to Powney and Watts (1987), semi-structured interview helps the researcher to find out what is happening and to seek new insights.

3. Goal of the interview/Nature of data collected **–** Since the critical quality success factors of employee empowerment, process and equipment maintenance have been the focus of the industry, it was important to understand from the perspective of the user, the criticality of the factors and their impact. Hence, a low degree of structure, coupled with open questions, was used with a focus on actions and situations specific to the subject of interest (Kvale, 1996).

4. Interview process completeness time **–** Most often than not, the researcher may deem it necessary to go back to the interviewees for additional data to assist in construct validation,

model testing, modification and extension, and interpretation of findings. As such, a significant length of time is required to obtain the required data from the interviewees (Saunders et al., 2000). King (2005) suggests the use of interview protocols for better time management.

However, according to Barribeau et al. (1994-2012), interview-based research comes with some challenges which includes

- Significant reliance on interviewer knowledge and expertise.
- Data obtained being largely qualitative.
- Labour intensive, making it difficult to use multiple assessors or to conduct multiple in-depth interviews of knowledgeable managers and still obtain a large enough sample to perform in-sample statistical analysis.

With these types of challenges, the researcher is inevitably faced with ensuring the reliability and validity of the interview responses. This is discussed in section 3.8.

Four specific ways in which qualitative method (interview) demonstrated usefulness in this study include:

1. Generation of hypotheses grounded in the reality of the industry
2. Understanding direction of causality
3. Having two sources, qualitative and quantitative, generated from the same population allows for immediate crosschecking and replication of results.
4. Provision of context that will enable interpretation of quantitative findings, while using quantitative data to establish the generalizability of qualitative findings.

3.5.2. Quantitative – questionnaire survey

According to Gable (1994), for a survey to succeed in elucidating causal relationships or even in providing descriptive statistics, it must contain all the right questions asked in the right way.

However, in case of quantitative survey (hardcopy or electronic), Kaplan and Duchon (1988) argue that the stripping of context buys objectivity and testability at the cost of a deeper understanding of what actually is occurring (p. 572). The consideration and choice of quantitative survey was influenced by the following

- Its relative strength, which compensates for the weakness in the qualitative method.
- Its ability to validate the literature findings discussed in chapter 2 and the findings from interview addressing the same issues.

The use of questionnaire surveys has the advantage of reaching many people within an organization relatively easily and allows for low cost, target specific, non-invasive ways for measuring aspects of an operational issue that in some cases may be latent or not directly observable (Sekaran, 2003). However, limitations include difficulties with respondents' interpretations of measures, potential lack of knowledge and representations of the unit of analysis, and survey fatigue, defined as an increasing unlikelihood to respond to surveys impacting response rate. According to Easton (1993), these limitations are addressed with pre-test, pilot test and choice of administering the questionnaire.

3.5.3. Questionnaire Design

3.5.3a. Design of semi-structured interview questions

According to Saunders et al. (2000), designing the right types of question is critical for the success of any interview. The interview questions (appendix B and C) which consists of a combination of open questions (Saunders et al., 2000, Easter-smith et al., 1991, Grummitt, 1980) and probing questions (Patton, 2002, Saunders et al., 2000) were designed to elicit more from interviewees on critical success factors (Easton and Jarrell, 1997) and consequently aid in answering research objectives number two (RO2). The style of questions include start words such as Why, How, Tell Me More About, What (Saunders et al. 2000). According to Patton (2002), interviewees could be asked experience and (or) behaviour questions, knowledge questions, opinion questions, feeling questions, sensory questions, background or demographic questions in order to get more in-depth information. Nevertheless, Healey and Rawlinson (1994) suggests that sensitive question be asked towards the end of the interview to allow enough time for the interviewee to build up trust and confidence in the interviewer. To encourage this build up of trust and confidence and to help answer first research question, the interviewee must do 90% of the talking (PRA INC). Despite its importance, an audio recorder was not used, as the interviewees did not want to be tape-recorded. However, the researcher took several notes during each interview so that vital points are captured.

3.5.3b. Design of quantitative survey questions

According to Converse and Presser (1986), although researchers could develop questions of their own, it is recommended that researchers first check published compilations of survey questions to adapt questions from surveys that reflect and are relevant only to their own research, saving both time and effort, since these questions and questionnaires have already been tested and used effectively.

To investigate the notion of personnel psychological empowerment therefore, this research will leverage, and extend Thomas and Velthouse (1990) four constructs of employee psychological empowerment (meaningfulness, choice, competence, impact) to include, responsibility and accountability and mindfulness (Ndubisi, 2012a). These seven elements, broken down into high level (the common and dominant antecedents amongst the five models) and low-level antecedents, will be used to test the notion of employee psychological empowerment. This approach will enable the organization focus more on key factors that enhance employee buy-in on quality while promoting strategy and vision at the same time.

Process was measured leveraging on the four items with significant factor loadings in Kaynak (2003), with some modification to suit the industry of study especially in language. Specifically, respondents were required to indicate the extent to which inspection reviews, or checking of work, is performed; extent to which processes are clearly communicated, extent to which hold points are built into processes; and designed to minimize the chances of employee errors (fool proof).

To investigate operational service quality, this study leveraged on the four items with significant factor loadings in Kaynak (2003), adapting it to suit the target industry. Specifically, respondents were required to gauge the extent to which their company achieved improved product and (or) service quality; increased productivity; reduced cost of defects and reworks; and reduced delivery lead-time of finished products and services to customers. An item adapted from Ahire and Dreyfus (2000) required respondents to rate the extent of achieved reductions in customer complaints. Measures based on prior literature include operational efficiency (Hopkins, 2012, Shaffle et al., 2011) and equipment maintenance (Hmida et al., 2013, Wilson, 2012, Levitt, 2009, Patankar and Taylor, 2004). Table 3.7 shows the constructs, literature reference, measures and survey items.

Table 3.7: Constructs and measures

Construct and Literature Reference	Measures	Item
Operational service quality [Subba Rao et al (2013), Ahire and Dreyfus (2000), Kaynak (2003)]	Rework levels, increased productivity, quality assurance, improved quality results, customer satisfaction, customer complaint reduction	A1-A6
Meaningfulness [Jöreskog (1993), May et al. (2004)]	Value, contribution, making a difference,	B1–B5
Responsibility [Baird and Wang (2010)]	Obligation, power delegation, three keys to responsibility: intention, awareness, and confront.	C1 – C6
Accountability [Blagescu et al (2011), Hall et al., (2003), Yukl and Becker (2006), Kopell (2005)]	Ownership, transparency, participation, evaluation, complaint and response mechanisms focus, influence, and consequences	D1 – D6
Mindfulness Baer et al. (2006)	Observing, describing, acting with awareness, non-judging, increased attention, non-reactivity	E1 – E7
Competence [Thomas and Velthouse (1990), Thomas and Tymon (1993)]	Skill, training	F1 – F5
Choice [(Kabeer, 1999), Hackman and Oldham (1975)]	Alternatives, flexibility, variety	G1 – G5
Impact [Thomas and Velthouse (1990), Thomas and Tymon (1993)]	Influence	H1 – H4
Process [(Kaynak (2003)]	Design, documentation, hold points	I1 – 17
Equipment Maintenance [Athens group (2010), Levitt (2009)]	Reliability, maintenance, failure,	J1 – J6
Operational service efficiency [Pietersen (2010), Shaffiel et al., (2011)]	Cost minimization, Design of processes, superb value	K1 – K4
Employee psychological empowerment [(Jejeebhoy, 1995), (Kishor, 2000, Hayes, 1994)]	Decision-making autonomy, Knowledge autonomy, Sharing of roles and decision-making, Access to training, Access to information	N1-N6

This study used the interval measurement scale, specifically the Likert (1932) response scale that measures data using equal intervals to compare differences between pairs of values. According to Sekaran (2003), unobservable issues most times can be assessed only through perceptual measures.

Zikmund (2003) general rule of questionnaire survey design was considered, enabling a concise and precise presentation of items in not more than six pages. To avoid bias due to response style (Nunnally, 1967), a set of four (4) or more items was ensured for each of the construct, maintaining an approximate balance between items for which 'strongly agreed' was the response and items for which 'strongly disagreed' was the response.

Adapted and modified questions were tested in the new environment of study to ascertain suitability and understanding. This was done in two stages of pre-test and pilot test before the final survey instrument for field test.

A total of 11 people comprising five (5) quality operations support managers, three (3) human resources managers and three (3) oil-field service supervisors, all from the oilfield service industry, reviewed the questionnaire and provided constructive insight. (See appendix H for pre-test questionnaire transcription.) At the end of the test in March 2014 which spanned over 4 weeks due to rescheduling of appointments, the draft questionnaire was restructured; scaling was left as is at 1 to 5, seemingly repeated questions were removed, some sentences reworded to better suit the industry.

The pilot test was conducted in April - May 2014 with 239 oil and gas field operation employees out of 300 purposively sourced via old acquaintances, LinkedIn and twitter using qualtrics online survey tool. The choice of e-survey over hardcopy is based on decreased costs, faster response times, and increased response rate, which may or may not be the case in reality. Easton and Jarrell (1997) define an electronic survey as "one in which a computer plays a major role in both the delivery of a survey to potential respondents and the collection of survey data from actual respondents" (P.2).

Pilot test helped to refine data collection plans with respect to both the content of the data and procedures to be followed (Yin 2003). According to Gill and Johnson (2002) pilot test allows any potential problems in the questionnaire to be identified and corrected. The relationship (1) of the variables was tested using standard ordinary least square estimation employing STATA application version 12.

$$yi = \alpha + \beta 1\ xi1 + \beta 2\ xi2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. + \beta n\ xn + ei \quad (1)$$

In the above relationship (1), yi is the dependent variable 'empowerment', which is measured as equally weighted index of ten 5-scaled responses for individual 'i'. x1 to x7 are the key explanatory variables that capture the accountability, mindfulness, responsibility, impact, choice, meaningfulness, and competence based responses for individual 'i', based on a similar index approach. Note that 'ei' represents the error term. The higher an individual 'scores' in each of these elements, the greater the sense of empowerment. Descriptive evidence of the sample is shown in appendix J, together with result obtained in the pilot study.

Based on the factor analysis performed on the pilot study data, the survey instrument was revised for field study, excluding all redundant and low factor-loading items represented by asterisks items in the survey tool (appendix I). A ten-point scale was however adopted instead of a five-point scale for better response representation (Zainudin, 2014). Furthermore, in contrast to the online survey method used in the pilot study, and due to the tremendous amount of energy expended on ensuring survey completion, the field survey was administered manually amidst the challenge of air travel and logistics.

3.5.4. Case study

Three oilfield service companies were studied to provide a richness of description and first-hand observation of phenomena in a natural setting (Jansen et al., 2007, Hartley, 2004). The reason for choosing case study organizations is a balancing act between the need to obtain rich informative data through rigorous investigations and the need to generalize the research findings while understanding and recognizing the differences in each case. According to Hartley (2004), "case or field-based studies provide a qualitative approach to studying a phenomena in-depth, particularly poorly understood or emerging phenomena" (p.340). Furthermore, multiple case studies augment external validity and help guard against observer biases (Yin 2003).

The value of case studies, according to Spratt et al. (2005), lies in its capacity to provide vicarious experience to the reader – to give the reader the feeling of 'being there' and perhaps to set him thinking about how he might respond to dilemmas and conflicts as events unfold" (p.31).

Two key sources of data, primary (first-hand information) and secondary (information from existing sources), as identified by Lodico et al. (2010) were adopted while adhering to ethical considerations and a set of principles in the data collection strategy, namely; the use of interview guide (Gillham, 2005, Saunders et al., 2000, King, 2005) and case study protocol (Yin, 2014). Given their efficaciousness in investigating quality improvement methodologies, together with illustrating success stories and the realities of its implementation in organizations (Heras et al. (2002), this study therefore sought data from multiple sources, specifically via document review (Simmons 2009), face-to-face interviews (Curasi, 2001), telephone interviews (Bonnel and Le Nir, 1998), questionnaire (Yin, 2014), company websites, company videos and prior material from literature review. Yin (2003) advocates the use of multiple sources for data collection in case studies. According to Gillham (2000), the use of multiple sources of evidence is a key characteristics of case study research (p.2) because *all* evidence is of some use to the case study researcher; nothing is turned away (p.20). However, according to Merriam (2009), finding relevant materials is a 'systematic procedure that evolves from the topic of enquiry itself' (p. 150). Therefore, formal and informal document types reviewed for this research study include, but not limited to, annual reports, quality operation audit reports, investor presentations, field operation and job quality books, end of well reports, pre and post job meeting reports, quality non-conformance reports, quality incident reports, news releases, and preliminary results announcements. According to Simmons (2009), document analysis is often a helpful precursor to observing and interviewing, to suggest issues that may be useful to explore in the case and to provide a context for interpretation of interview and observational data (p.64). As highlighted by Mellat-Parast et al. (2007), accident investigation delves into the process, procedures, policies and people interfaces that guide the operational existence of an organization, thus can become a tool for gaining insights into empowerment and its advancement, and quality improvement.

According to Harleysville (2008) "learning from failure is as much a social process as a technical exercise" (p.646). Thus it is only logical to take a cue from their findings as it occurs in each industry to provide a framework for operational quality tailored to that industry.

The researcher was granted access to a few relevant databases, however confidentiality clauses implication limited disclosure without authorization.

The steps undertaken in studying the case companies is summarized into seven (7) distinct but overlapping and interactive steps adapted from McLean (2006) organizational development process model (ODP). These steps include

1. Access
2. Start-up – Explain objective and benefits of study.
3. Assessment - The assessment of employee psychological empowerment will be done using the evaluation kit validated by Narayan (2005). Designed to measure the extent to which the employees feel empowered to carry out their duties on behalf of the organization, the evaluation kit (Appendix G) comprising of 24 questions covered four key areas of empowerment.

The assessment question will be manually administered to a cross section of the field employees. According to Parmenter (2007), a cross section sample survey respondents required to find out the current perceptions on existing performance information in the organization should not be greater than 200 or 10% of total staff, and not less than 50 staff. With these numbers, according to Parmenter (2007), the survey can yield a 60% return rate and still have a valid survey. Too large a sample will make data mining more difficult and seldom raise any new issues (p. 62).

To complete the survey, the respondents are asked to choose from the scales by placing the appropriate number in the box next to the statement with 7 being critically important / totally effective.

Sample question

Participation in decision making	Importance	Effectiveness
As I gain expertise I am allowed more latitude on my job.	1 2 3 4 5 6 7	1 2 3 4 5 6 7

As I gain expertise I am allowed more latitude on my job. Importance (6) Effectiveness (2)

In the example above the respondent indicated that he/she should have considerable opportunity for independence in how he or she does his/her job (6 under Importance), but the organization is less than 'somewhat effective' in this area (2 under Effectiveness).

4. Feedback and action plan to address gap – To prompt a discussion regarding the findings, a series of questions could be asked including the reasons for the findings, the most critical issues, the biggest gaps between what the data portrays and what is expected and the key actions that should be taken.
5. Implementation of action plan
6. Evaluation – The impact of the implemented actions is evaluated having given adequate time for implementation and the expectant result. According to McLean (2006), in addition to developing a plan of action based on survey results, it is important to evaluate whether the interventions produced intended consequences.
7. Separation - A formal separation can be initiated after feedback is communicated to relevant person(s). The key thing at this stage of the process is to leave the door open for future correspondence if any.

Figure 3.2 is a representation of the 7 steps undertaken.

Theoretical Steps	Actual Steps	Outcome of Steps
1. Access	Apply and obtain approval for research opportunity. Start consultations	Access granted. Identify key persons
2. Start-up	Schedule meetings and interview with experts Review documents e.g. quality books, end of well reports, etc.	Gaps and quality challenge identification Detailed outline of causes of NPT
3. Assessment	Conduct initial empowerment survey Analyze result	Empowerment level identification, gap analysis and action plans
4. Feedback and action plan	Share findings and agree on remedial actions. Segregate remedial action into long/short term and agree on implementation timeline	List of actions to carry out and schedule.
5. Implementation	Implement short-term actions and lay foundation for long-term goals	Monitor and record implemented actions progress
6. Evaluation	Review and compare post implementation reports with pre-implementation reports Conduct final (2nd) empowerment survey and compare with initial	Progress report, conclusion and recommendation
7. Separation	Discuss result with stakeholders Leave contact and exit	Feedback and established foundation for improvement. Exit, keeping future contact

Figure 3.2: Case Study steps

Note: Stakeholders=operations, quality, and maintenance managers, field service managers, field supervisors, HR personnel.

The use of case studies for research purposes, according to Capel (2012), remains "one of the most challenging endeavours" (p.1).

One of the main challenges experienced prior to undertaking this case study was gaining the opportunity (access) to investigate the identified oilfield service companies. Four key considerations of the companies before access were granted included:

1. Potential benefit of research to the company. The potential benefit of identifying bottlenecks in operation and subsequent improved quality of operation was highlighted to the operations manager prior to commencement.
2. Relationship of researcher with competition or potential client (if any) that might raise a red flag or necessitate an exemption to be raised. An exemption is an official permission granted by the company's legal team after all risks are assessed. Fortunately, this was not required.
3. The information access level to be granted the researcher. The company database access level that was granted the researcher was such that confidentially classified information was not accessible. However, the relevant and expert respondents were on hand with clarifications and insight when needed.
4. Time and resource allocation requirement on the company. For effective work while on the research, there was need for an office space (howbeit shared), access to relevant databases, opportunity to participate in quality incident analysis and interview of personnel. These were all granted.

Another challenge faced by the researcher was how to strategize without giving up the central goals of the research and compromising its independence. To reach a balance, a confidentiality document was signed which governed the terms of the case study. Nonetheless, there was a need to establish trust and be seen as an insider in order to establish the necessary relations with specific persons to interview and observe. To accomplish this, the researcher had to fall back on previous work experience and background in the oilfield industry. The familiarity enabled discourse on aspects of the efficiency-thoroughness trade-off, also known as the ETTO principle, (Walliman, 2001) that characterize much of the work, which perhaps might not be in the public domain. The insider position enabled the author to view from a different perspective, hence profit from a double description - a concept that metaphorically compares with depth of vision made possible by binocular vision (Bateson 1982). This has been an important premise for this study.

To control the challenge of flight cost, hotel accommodation together with time while operating on a self-financed budget, the researcher sometimes relied on live conference calls, quality incident reports documented real time and analysis of limited data set to examine associations. Where resources allowed, preliminary findings were taken back to key informants at the operational base for interpretations of causality or association, as the case may be.

In spite of the challenges, which according to Boyer and Swink (2008) can be seen as risky, Capel (2012) indicates that the need to undertake a case study arises out of the "desire to understand complex social phenomena" (p.2) and are a preferred strategy when "how or "why" questions are being posed, when the investigator has little control over events (pp.5-10) especially within some real-life context as put forward by Yin (2003b). The detail and result of the case studies is presented in Chapter 4.

3.6. Sampling

A sample is a limited number taken from a large population for testing and analysis on the assumption that the sample can be taken as representative of the whole group (Crouch and Housden, 2012 , p.149). Sampling techniques provide a range of methods that enable researchers to reduce the amount of data needed to draw valid conclusions about a given population (Saunders et al., 2000).

Divided into purposive and random sampling methods (Merriam, 2009), this study undertook purposive sampling method. According to Patton (2002), the logic and power of purposive sampling lie in selecting information-rich cases for study, to yield insights and in-depth understanding, rather than empirical generalization. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry (p.230).

The selection of cases for this study and the sampling of the people within the case (Merriam, 1998) are discussed next.

3.6.1. Sample Selection and Justification

The 2014 directory of the Malaysian oil and gas service council (MOGSC, 2014) and the oil and gas ecosystem developed by the Malaysian Investment Development Authority (MIDA) was used as a guide to achieve the sampling frame used for case selection.

The MOGSC 2014 directory lists all oil field service (OFS) companies in Malaysia (411 corporate and 35 associate members), thus a random sample from this directory is representative of the Malaysian context. However, due to the focus of this study on those companies with an industry recognized quality focus, the oil and gas ecosystem in the country (appendix D) from Malaysian Investment Development

Authority (MIDA), in cooperation with the Malaysia Petroleum Resources Corporation (MPRC) was used to narrow the list.

Out of the 100 companies shown in the ecosystem as offering either well intervention and (or) well completion services, 5 were portrayed by MOGSC 2014 as key players in the industry offering both equipment rental and integrated well completion services, and citing other parameters such as company profile, global staff strength (over 80,000 employees), revenue base, ISO status and industry reputation. These parameters signal that the companies not only have the resources to implement formal quality initiatives (Van der Wiele and Brown, 1998, Ghobadian and Gallear, 1997, Price and Chen, 1993) but have undertaken them.

For this study, an ISO certification status is considered to assure a quality focus. Although ISO certification in itself does not necessarily correlate with improved quality (Naveh and Marcus, 2004), companies that have achieved ISO certification typically move on to adopt total quality as the next stage in their quality journey (Tannock, 2010) supporting Dale (1999) view that a successful implementation of total quality is predicated on the quality systems such as ISO 9000 as prerequisite. ISO certification benefits, which are all quality oriented, can be divided into three categories of customer, industry and regulator.

- For customer– Achieving and maintaining certification to ISO 9001 lends credibility to an organization (karapetrovic et al., 2010), giving the customers an added level of assurance that a business does what it claims to, that this can be documented, and that problems will be resolved, not ignored.
- For industry– ISO certification is considered an invitation-to- tender requirement to gain access to certain market in the industry (Douglas et al., 1999). The certification also implies a focus on cost and delivery time reduction; and facilitates

trade across borders by replacing the multiplicity of existing industry, regional and national standards, as well as specifications developed by individual companies.

- For regulators– With constant review of standards, high safety levels are facilitated while at the same time providing the technical platform and structure for regulations helping them to easily zoom into those key elements that have the greatest impact on product and process control.

Figure 3.3 shows some of the benefits of ISO as highlighted in comparative study performed by Karapetrovic et al. (2010).

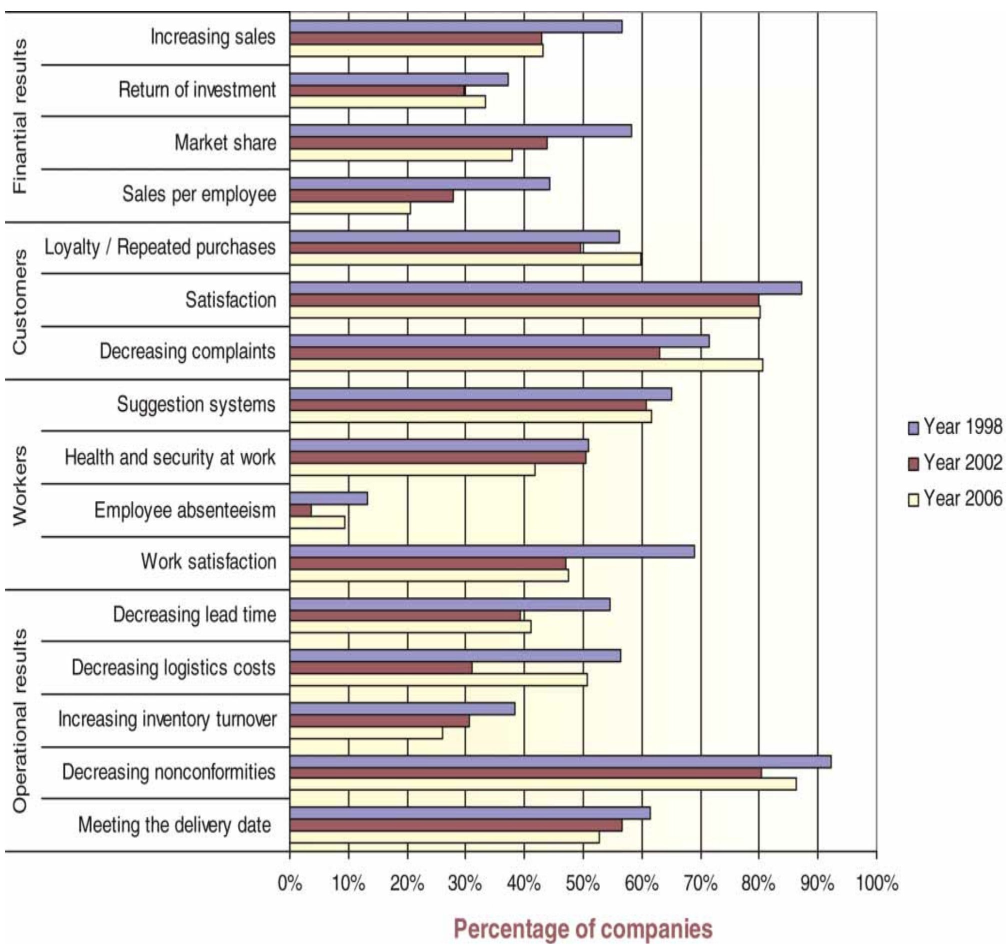


Figure 3.3: Benefit of ISO 9000 implementation

Source:Karapetrovic et al. (2010)

The figure shows some of the operational quality results as decreasing lead-time, decreasing logistics cost, meeting delivery date and decreasing nonconformities. Thus the selection focus narrowed on the five key players whose activities, according to Crouch and Housden (2012, p. 161), are of so much significance in the market place that any survey not including them could not give a valid picture of what is happening in the market.

In addition, due to financial and logistic constraints which according to Crouch and Housden (2012), is a "practical reality" (p.166), this research focus was delineated to those with physical presence in researcher's city location at time of study, to eliminate disruption to research progress even when the researcher is not physically present at the operational bases located a 2-hour flight time away from the city. Although these five key players consented to being part of the semi-structured interview process and quantitative questionnaire survey, persuading all but one of them to participate as case study companies that would allow the researcher to observe closely the environment of study and validate or support quantitative findings at the end, proved very challenging and unsuccessful.

This cautious disinclination to participate amidst all attempts, demonstrates the nature of the industry as very competitive, with information considered largely confidential and closely guarded. Perhaps this is because the sector holds in their databases, industry-specific measures or metrics that are considered the 'harder numbers', which feed directly into models and 'move the market' (Baker 2013).

Furthermore, according to Chin et al. (2011), industry and university research collaboration in Malaysia is still at its infancy with most collaborations individually initiated, and the amount of time and effort involved to convince industry partners vary significantly and the process is considered to be a ‘very challenging ordeal’.

To further the course of this research in the light of the unsuccessful attempts to gain more key case study companies to work with after the quantitative survey, this study sought other medium oilfield service companies whose profile of clienteles showed good industry reputation, quality focus, offers integrated services and well completions, national in makeup and familiar to the researcher. This situation is described as opportunistic research (Riemer, 1977) or peripheral member – researcher (Adler and Adler, 1987, Adler and Adler, 1994). According to Adler and Adler (1987), this choice is usually encouraged especially in situations of time constraints and difficulty in obtaining access to other or more relevant applicable research targets. Thus three companies, with background and profile as shown in appendix F4 and henceforth known as OFSC-A, OFSC-B and OFSC-C, were utilized as case companies for the validation exercise at the end of the quantitative survey analysis.

This number is considered suitable for this study. As pointed out by Easter-smith et al. (2012), even single cases can be uniquely interesting especially if the company does significantly better (or worse) than all the others in the same industry. Furthermore, according to Siggelkow (2007), it is often desirable to choose particular organizations that allow one to gain certain insights that other organizations would not be able to provide. In this case in point, as argued and supported by Easton (1993), incorporating other companies with unproven quality related initiatives in a quality performance related study will mean the results of the study would have little to do with quality and without a measurable outcome.

3.6.2. Selection of Respondents and Justification

Since this study primarily investigates the importance of empowerment, equipment maintenance and process on operational service quality, the targeted and sample respondents must be from the population of field operation personnel that directly impart quality operations. Hence, the selected respondents would be based on their employment designations as field operation personnel – those categories of employees that have perform(ed) field and (or) maintenance operations.

To gain more insight and address research question for this study, subject matter experts were interviewed who, according to Kaynak (2003), are better aware of the organizations' operations and quality initiatives to improve efficiency, as well as having better access to the financial performance information of their respective organizations based on the initiatives. According to Lee (2013), information on this economically important sector, the oil and gas sector, is scant and limited, hence subject-matter expert-input becomes indispensable. Furthermore, Baker (2013) survey of investor and analyst first and second priority sources of information in the oil and gas sector, suggest that the most cited source for information on company strategy and risk are from direct dialogue with management *(expert positions)* and investor presentation (p.27).

The number of subject matter experts initially interviewed for this study was seventeen. This number is considered to be adequate as the companies represented are the dominant oilfield service companies in the world and represented in Malaysia with well over 80,000 people in each of their employment globally at the time of this study. According to Bryman (2012), there is little definitive and unambiguous guidance in the qualitative research community regarding how large a sample should be. This situation is reflected in the contrasting figures suggested as minimum requirements for interview sample size ranging from 12 - 20 suggested by Adler and Adler (1987), to 20 - 30 suggested by Warren (2002) and 60 - 150 suggested by Gerson and Horowitz (2002). Nevertheless, Crouch and Housden (2012) conclude that the appropriate sample size must be worked out with respect to the needs of each particular survey. This according to Ghauri et al. (1995), is usually a complicated task often requiring compromise.

Furthermore, the difficulty in securing agreement with the experts and organizations (Brannen and Nilsen, 2011), the harrowing job of transcribing interview data, the time constraints and the 'publish or perish world' in which we live in (Adler and Adler, 2011) cited in Baker and Edwards (2012), and other practical realities (Crouch and Housden, 2012) make it a good enough number, and particularly so when it is followed up with quantitative survey.

The ideal respondents for the quantitative questionnaire survey therefore would have been involved in pre-job preparation, on-the-job execution and post-job demobilization. They are the ones who are at the field and most times are the service themselves. The HR and the quality department heads assisted to ensure that this is the case for this study along with choosing as primary location, the field operation bases of the selected three case study companies. These locations serve as the base for all field operation personnel, from where personnel and job mobilization is initiated. A selection of respondents from this pool gives more assurance of target respondents.

3.7. Data Analysis and Justification

According to Corbin and Strauss (2008), analysis is a process of generating, developing and verifying concepts that are built up over time and with the acquisition of data. Hence data analyses give meaning to the data prepared. The methods and steps employed for the analysis of data collected via interview, empirical survey, and case studies in this study are highlighted below.

Interview data analysis and justification – There are different interview data analysis processes such as those of authors like Kvale (1996), Bryman (2004) and Gillham (2005). However, authors, such as Saunders et al. (2000), maintain that there is no standardized approach to the analysis of qualitative data. According to Kvale (1996), the central task of interview analysis rests with the researcher, with the thematic questions he or she has asked from the start of the investigation and followed up through designing, interviewing, and transcribing (p.187).

Hence, according to Saunders et al. (2000), one way of analyzing data gathered via qualitative interview is by thoroughly reading and re-reading transcripts and notes of interviews or observation. This allows the researcher to examine, rearrange, categorize, tabulate or recombine the data systematically and rigorously to address the propositions of the study (Yin 2003).

An eclectic or bricolage analysis (Kvale and Brinkmann, 2009) of the responses from subject matter experts interviewed will be performed via a five-step qualitative analysis process designed to ensure that patterns and themes that might emerge from the data could be carefully verified. In a bricolage of mixed methods, there is no epistemological primacy accorded to any method and technique. The steps, which are a combination of techniques

(Kvale and Brinkmann, 2009) include:

(a) Collecting the interview data

(b) Reviewing, transcribing notes from the interview

(c) Summarizing the notes from the interviews.

(d) Coding of the data with key words as a way of identifying commonalities and variations (Bryman, 2004, Strauss and Corbin, 1990)

(e) Identifying common and variable patterns, and identifying themes which link or explain the data (Miles and Huberman, 1994, Patton, 2002).

These steps are particularly suited for this study, as there was no particular requirement for interviewing and transcription, such as video or audio recording during the interview, eliminating the use of any computer assisted transcribing software.

Data collected is manually transcribed and converted into written records immediately after the interviews assisted by the interview guide. This helped avoid limitations of interviewer remembrance (Kvale and Brinkmann, 2009) – a discipline that is supported by Stake (1995) and Yin (1994, 2003), to ensure that all aspects discussed were captured. This on-going process, according to Merriam (2009), keeps the data from becoming unfocused, repetitive, and overwhelming in the sheer volume of materials that need to be processed, making the data both parsimonious and illuminating (p. 171).

To perform the analysis, the key points of the different responses were broken down into its various components and examined for identification of properties and dimensions as advised by Corbin and Strauss (2008). The responses were first divided into topic and comment units (Clements, 1979) by identifying each clause and then segmenting the clause into topics and comments on topics. Since the interview responses are instrumental to the study (Stake, 1995b), all interviewee responses were analyzed using an open coding procedure specified by Strauss and Corbin (1990). This procedure allowed the researcher to segment the data, determine its superordinate and subordinate categories for the factors under study, the comparison between them and, when possible, locate the dimensions of subcategories along a continuum.

All the reports were reread and reviewed a couple of times to derive meaningful categories and match up to the developed codes. The data coding is constructed with focused attention on commonalities and variations, with labels manually created by the researcher based on both context and on academic terms.

The coded words included key performance indicators (KPIS), challenges (KPIS-CHAL), quality (QUAL), maintenance (MAINT) and empowerment (EMP-STRAT), all of which were used several times in the discussion. Evidence of the presence of key performance indicators, as well as the other major words, was coded. The themes were referred back to the original interview data to validate the subjective responses, and a description of the phenomena. Phrases, categories, and themes were evaluated, examining each by crosschecking the findings for internal consistency and delineating essential relationships between the themes (Creswell, 2007). The manual coding facilitated classification of situations and narratives into perceptions that are related to the research questions and conceptual model. According to Merriam (2009), coding simplifies data identification making for easy recovery.

In demonstrating validity, which according to Golafshani (2003) is by no means static or universal, the coding was used to reduce the probability of making invalid links while seeking evidence to disconfirm the assumed link in the research.

Furthermore, the sample selection of key players in the industry maximized the analytical generalizability of this study.

Questionnaire survey data analysis and justification – In order to make fundamental conclusions from any data set, a careful analysis need to be performed on the data which often times require data to be screened, coded and investigated using statistical software. For this study, statistical package for social sciences (SPSS) version 20, an analytical software deemed the most widely used statistical software (Muijis, 2004), was used.

In order to measure the relationships amongst the constructs, a series of statistical techniques were utilized. These statistical techniques, in chronological order, are:

(a) Reliability Test (Internal Consistency)
(b) Exploratory Factor Analysis (EFA)
(c) Confirmatory Factor Analysis (CFA)
(d) Structural Equation Modelling (SEM)

Reliability test is a measure of internal consistency expressed by Cronbach (1951) alpha value. A value of above the 0.7 thresholds are considered as consistently measuring respective hypothetical concepts on a summated scale. The results will imply that the questionnaire is measuring the antecedents of the constructs in a meaningful and consistent way.

Exploratory Factor Analysis (EFA) - The objective of EFA is to examine possible relationships in only the most general form and then allow the multivariate technique to estimate relationships (Hair et al., 1998). It is considered a data reduction technique.

Confirmatory Factor Analysis (CFA) - also known as measurement model, assigns variables to manifest a particular factor, called a *construct*, where the manifestation is the strongest. This strength of manifestation is measured by factor loadings in the complex factor structures. When variables are assigned or confirmed, these variables become a linear combination of their respective factors (Marsh and Hau, 1999).

Structural Equation Modelling (SEM) –is generally used to estimate "multiple and interrelated dependence relationship and the ability to represent unobserved concepts in these relationships and account for measurement error in the estimation process" (Hair et al., 1998 ,p.584). Described as a multivariate technique (Zainudin, 2014), SEM estimates the structural or path and measurement models (Lei and Wu, 2007). According to Hair et al., (1998), the structural model is a "set of one or more dependence relationships linking the hypothesized model's constructs" (p.583) while the measurement model "specifies the indicators for each construct and assesses the reliability of each construct for estimating the causal relationships" (p.581). The use of SEM for this study is useful in estimating the separate, but interdependent factors simultaneously in a specified structural model.

The choice to analyze the collected questionnaire data in this study using structural equation modeling (SEM) as a form of analysis stems from the challenge of meaning, causality and comparability, as described by Alsop et al. (2006), that arise when operationalizing and analyzing complex issues such as personnel empowerment which is part of the focus of this research. Identifying *meaningful* measurements, of the multi-dimensions of personnel empowerment has proven to be a challenge, leading authors such as Alsop et al. (2006) to conclude that its measurement are often "contextual and difficult to universalize" (p.88) and most of all "messy"(p.31). Graham and Pettinato (2005) suggest that any approach to measuring and analyzing empowerment has to capture dynamic processes and relational changes that are less predictable, less tangible, more contextual, and more difficult to quantify in data collection and analysis.

Causality has to do with making a connection between the intervention and the expected outcomes/impacts. According to Mulaik (1987), the concept of causality has to do with probabilities and not specific outcomes. However, according to Noronha (2002), this definition has been challenged by the notion of a cause as a 'producing agent' (e.g. If X is a cause of Y, then a change in X produces a change in Y). This supports Blalock (1961) argument that causal inferences belong to the theoretical level, whereas actual research can only establish covariation and temporal sequences (p.172). As a result, one can never actually demonstrate causal laws empirically.

In discussing empowerment, Alsop et al. (2006) states that, "empowerment often allows people to choose not to take action. Thus even when they choose to take action, it is difficult to determine if it is a strategic or dependent form of action"(p.31). Perhaps, that could support Narayan (2005) stance that it is easier to measure the effects of empowerment than empowerment itself (p.242). But Alsop et al. (2006) maintains that attributing cause and effect can be relatively straightforward when the causal chain is fairly short and when other variables can be held constant. Hence a causal inference can be suggested if the research design is highly favourable towards such inference (Hoyle and Panter, 1995). Therefore, establishing causality in structural models using non-experimental data is largely a matter of interpreting the research results with theoretical support and of course, common sense (Noronha, 2002). According to Hoyle and Panter (1995), 'if the research methods and design that generated the data favour a causal inference, then such an inference can be made. Otherwise, the appropriate inference is that variables are reliably associated in the context of the model but the exact nature of the association cannot be demonstrated' (1995, p. 175). This approach, according to the Hoyle and Panter (1995), should be extended to answering complex questions in the social sciences *such as empowerment*, even though SEM provides necessary but not sufficient conditions to establish causality.

Therefore, since this research is not trying to prove that personnel psychological empowerment 'causes' quality improvement, but to identify an association with quality improvement to support the combination of its effect on performance, the resultant outcome of using SEM for this study can thus be interpreted in terms of 'associations' rather than 'causes'. Same position is held for the rest of the model components.

Comparability has to do with the practicability of data generalization across populations so that conclusions about impact and change can be inferred for larger population groups. According to Alsop et al. (2006), the major problem is that empowerment often involves relative rather than absolute changes in states of being. Hence, an observable move toward a higher state of empowerment for one person or group cannot be assumed to apply to other individuals or groups. However, according to Narayan (2005), most of the elements that contribute to empowerment can be identified and documented, with rough if not always very exact measures.

In summary, the use of SEM allowed primarily an evaluation of whether the theoretical models are plausible when compared to observed data.

The data obtained from the case study companies, mainly through being a participant observer (Olivier, 2010) to allow for contextual interpretation, was compared with literature review, interview and quantitative data findings – and conclusions were drawn using triangulation method (Simmons, 2009). Triangulation is a method used to understand the historical context within events such as company documents, that increases the validity of findings in reflection to the theory postulated (Stavros and Westberg, 2009).

According to Brown (2008), the three key perspectives from which analysis of case study research has been viewed are namely methodological perspective (Yin, 2005, Yin, 2003a, Yin, 2003b, Yin, 1999, Yin, 1994, Yin, 1984, Yin, 1981), educational perspective (Merriam, 2009, Merriam, 1998) and interpretative perspective (Stake, 2008, Stake, 2005, Stake, 2000, Stake, 1995a). Although these three perspectives are seemingly distinct, Brown (2008) writes that 'qualitative case study research is supported by the pragmatic approach of Merriam, informed by the rigour of Yin and enriched by the creative interpretation described by Stake' (p.9). Thus, according to Brown (2008), it is safe to assume any of the three perspectives, and (or) incorporate the views depending on the researcher's understanding of its place in the research process, and the confidence in the research paradigm from whence s/he works.

3.8. Validity and Reliability

Validity and Reliability for quantitative researches is often considered straightforward, practical and testable as it depends on the instruments construction unlike in qualitative data where the researcher plays a significant role in the understanding of the subject (Patton, 2002).

Nevertheless, to demonstrate the validity for both methods, a participating pre-test method was first used instead of an undeclared pre-test (Converse and Presser, 1986). In the participating pre-test, the respondents were told it was a practice run and asked to explain reactions to question wording, language and order. This kind of pre-test helps determine effectiveness of questions and the understanding of the survey instrument designed, thereby establishing coherence and pertinence of result (Drucker-Godard et al., 2001). A further Pilot study or undeclared pre-test, usually refined after initial pre-test, is administered as intended for real to a different set of respondents from the same population. This type of test allows one to ascertain choice of analysis and the standardization of the survey (Converse and Presser, 1986). The external validity, which refers to the degree to which findings can be generalized across settings (Yin, 1994), is assured by the selection of the sample from the representative population.

The maximum degree of control as achieved by the research design also supports the validity of the study (Sekaran, 2003). According to Judd (2010), attempts to measure social phenomena are usually regarded as lacking rigour. However, Yin (2003b) maintains that rigour is derived from linked stages in the measurement process which include,

-Process of conceptualization of measurement

-Design of the measuring method

-Reliability and validity of the information and

-Analysis of the measurement.

Jöreskog (1993) argue that rigour can be inferred if these linkage stages are fulfilled. The measuring process of any phenomena is based on conceptualization of what is to be measured and while there may be no perfect solution, the premise established by the conceptualization process should at least be tenable in relation to the intended use. The designed method for measurement should be well defined, repeatable, and transparent, aiming to minimize biases and yield a level of accuracy that is sufficient to make the measures useful. Furthermore, it should also be susceptible to the scrutiny of those who are interested in using the resulting measurements. This means that it should be demonstrated that repeated measurements yield consistent results, and that these are meaningful within their context, that they correlate to other assessments of the same concept and that they are useful in making generalizations. Analysis of the measurements is possible through established methods for data processing, mainly through the use of statistical techniques that allow the estimation of characteristics of the population, measurement of variability and precision and formal testing of the hypothesis.

It will therefore not be out of place to state that the process adopted in this study addressed the challenge of adequately meeting the demands of rigour.

3.9. Ethical consideration

As noted by Marvasti (2004), because researchers often enter into relationships with the subject of study, the nature of the researcher's responsibility in the relationship he or she enters with those being studied needs to be considered. According to Saunders et al., (2000) ethical consideration in research study focuses on the appropriateness of the researcher's behaviour in relation to the rights of those who become the subject of the work, or are affected by it. The fundamental ethical principle in any research, regardless of chosen methodology, according to Simmons (2009) is to 'do no harm' which in the view of Henn et al. (2009) may either be physically, psychologically, legally and professionally. This concept, according to Simmons (2009), is not a straightforward concept due to individual differences imperceptions, and interpretation of what may constitute ‘harm’. Thus Simmons (2009) argues that focusing too much on ‘doing no harm’ may prevent from seeing the potential in the research process to contribute positively to the participants’ experience. Nevertheless, the ultimate ethical act according to House (1993) is the balancing of conflicts that may arise among ethical principles, however abstract in nature, and the necessity of trading off one against the other in concrete situations.

The social research association (SRA) ethical guidelines as cited by Henn et al. (2009) states that ‘no generic formula or guidelines exist for assessing the likely benefit or risk of various types of social enquiry. Nonetheless, the social researcher has to be sensitive to the possible consequences of his or her work and should, as far as possible, guard against predictable harmful effects” (SRA, 2003)(p. 17). This study therefore will follow the best practices and research ethical consideration given by Saunders et al., (2000) regardless of research methodology, which advises researchers to

- Respect intended and actual participant’s right to privacy
- Avoid deception of participants by disclosing reason and purpose of research
- Respect assurances given to and (or) provided by the participant on confidentiality, anonymity and use of collected data.
- Maintain objectivity during the data collection, analysis and reporting stages.

Hence in establishing an ethical approach for this study, the study design, process of data collection and analysis was subjected to the University of Nottingham, Malaysia Campus code of conduct (The University of Nottingham, 2007), ethical committee for review and approval. This process, which required informed consent procedure and explanation of methodology, ensured that any oversight on the part of the researcher or ethical pitfalls is addressed. With respect to the three research approaches (interview, questionnaire and case study) adopted for this study, an indication of awareness of ethical behaviour when collecting data from human participants was demonstrated by submitting the completed awareness of ethical behaviour for data collection document (appendix A).

3.10. Chapter Summary

This chapter outlined the research workflow employed in this study, including the choice and justification of research paradigm adopted. It also showed how the research approach adopted for this study was used in practice to investigate the conceptual model and subsequently in answering the set of research objectives of this research. The next chapter discusses the results and the analysis of result.

CHAPTER 4 RESULTS AND ANALYSIS

> "The goal is to turn result into information, and information into insight "
>
> (Carly Florina, Former CEO of HP, 2004)

4.0. Aim

This chapter presents the results and findings from the interviews, questionnaire survey, as well as the findings from the three case studies used in enriching and validating quantitative findings. The findings from the interviews are presented as a narrative whereas the survey results are presented in three parts. The first part reveals the characteristics and demographics of the sample respondents. The second part (i.e. descriptive and reliability analysis) is general findings on the antecedents of employee psychological empowerment. Finally, the last part (i.e. factor analysis and structural equation modelling) details the result and findings of the relationship between employee psychological empowerment, process and equipment maintenance and its impact on operational quality. The case studies results are presented as a comparison between the situation prior to and after implementation of a number of planned actions.

4.1. Introduction

Reporting findings in a mixed methods study is complex due to the vast amount of data collected (Gioia, 2004). Nevertheless, data can be checked against one another to elicit meaning, reliability and validity. According to Merriam (2009), what someone says in an interview for example, can be checked against on-site observations or what is read about in documents relevant to the phenomenon of interest (p. 216).

4.2. Result and analysis of the Interview

Analysis of interview data is usually problematic in that the data, which are never simply raw, are both situated and textual (Mishler, 1986). The semi-structured interview was administered to 17 subject matter experts from the five companies, which include Halliburton (5 personnel), Schlumberger oilfield services (5 personnel) and Baker Hughes (3 persons), Weatherford (1), Petrofac (1) and Bureau Veritas (2). The distribution of the interviewee profile is shown in Table 4.0.

Table 4.0: Distribution of subject matter experts interviewed

Subject Matter Expert Position	# Interviewees’
HR Managers	3
Field Operation Managers	2
Field Service Managers	3
Maintenance Workshop Supervisors	3
Service Quality Manager	3
Job Supervisor / Engineer in Charge	3
Total	17

When probed on the critical success factors of their operation, the interviewees described that the focus of rendering flawless service is enabled through their competent personnel, unique technology, equipment and the quality focused processes. However the technology aspect was not elaborated, as the interviewees reiterated that the technology aspect is managed at their respective organization research and development centres, narrowing the focus of the discussion to the three remaining aspects of employees, equipment maintenance and processes.

Table 4.1 provides the major results of the coding analysis of 17 interviewees' responses to describing their operational quality key performance indicators, with significant emphasis on non-productive time. The Table shows 3 major categories (personnel empowerment, process and equipment maintenance) and 24 sub-categories emerging from the analysis of key performance indicators (KPI) used. The major categories mirrors already discussed categories in the literature review.

Table 4.1: Major categories of operational quality service

Major categories	Sub categories
Personnel empowerment (EMP-STRAT)	Personnel empowerment, competence, participation, training, assessment, performance appraisal, coaching, access to information, knowledge, accountability, challenges, employment status
Process (PROCESS)	Procedures, rules, process challenges, standard operating procedures, quality management system, total quality management
Equipment maintenance (MAINT)	Maintenance system, equipment failures, maintenance team, maintenance type, maintenance challenges, maintenance team career path

Table 4.1 indicates that for each of the major categories, there is between 6 and 10 subcategory associations with personnel empowerment (EMP-STRAT) category having the highest subcategories. Note that all elements in the indicated subcategories are similar terms put together as elucidated from all the interviewees. As noted from the table, the respondents used nearly 50% more clauses to describe the employee or

human aspect (EMP-STRAT) than in describing or relating to process. This suggests that the dominant category most frequently referred to in discourse of key performance indicator was the “human” or employee aspect. Furthermore, dominating this human factor element is the aspect of personnel training and competence with both making up 80% of the concepts associated with the employee empowerment variable. The challenges experienced under each of the major categories coded uniquely as KPIS-CHAL during analysis although reported as a narrative, also highlighted employee factor as being critical together with emphasis on the financial implication of the challenge. This suggests that improvement efforts depend a great deal on the employees. However, one subcategory less frequently emphasized was the ‘employment status’ implying that it is not an aspect perceived by the management as a distinguishing factor in successful quality operation.

The second most emphasized main category is the equipment maintenance category particular reference to maintainability. As a measure of maintenance performance, maintainability is an ability of an item to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources. The two dominant subcategories in this category include maintenance system and maintenance team. These are closely followed by equipment failure, maintenance type and maintenance challenges, which received an almost equal emphasis from the interviews’. The sixth subcategory, which refers to maintenance team career path, was least emphasized. The benefit of a maintenance system was highlighted as bringing structure to maintenance, enabling performance measurement and allowing better financial planning on maintenance resources.

The third emphasized superordinate category associated with operational quality service relates to ‘process’. This has been coded distinctively as process in order to accommodate all identified context such as procedures and systems. In the interviewees’ responses, process was considered standard in the industry and was commonly referred to as operating procedures or the strictly outlined or designed way of carrying out the operation for which a deviation from is frowned at. In the discussion on process, the emphasis again was more on the employee interaction with the laid down procedures.

Table 4.1 highlights therefore that the superordinate category of ‘maintenance’ was referred to less often than ‘employee empowerment’ but more often than ‘process’ in the interviewees' descriptions of operational service quality critical success factors. Taking together, the dominant dimension in the discourse of challenges experienced, suggest that programmes or tools introduced to improve operational quality are mostly targeted at improving the culture of adherence thereby are human related. This supports views of authors such as Covey (2014), who have stressed that employees are the key assets in the quest for operational quality and efficient operations.

Below are the insights and themes that emerged from the interview conducted, and with a focus on the conceptual framework. These insights are grouped under the major headings of empowerment, process, equipment, operational service quality and operational efficiency.

4.2.1. Employee Psychological empowerment

Discussed under the term ‘personnel management’, the employee psychological empowerment strategies as described by the interviewees and employed within their companies include:

1. Competency: - The interviewees explained that due to the important and crucial role employee competency plays in operations, strict recruitment programmes are adopted in hiring new persons from universities and supported with a series of identified in-house courses and trainings. Authorizations or certifications to perform any job or operation are given only after the relevant in-house courses are taken and exam or assessment passed. These courses are usually industry-standard trainings, whereas some are company-specifics based on service offerings. Nevertheless, some courses do not require competency test. In such cases, the employee attends the course and gains some hands-on experience, which is considered to be sufficient for the job. These trainings however, are more stringent for field operation and offshore personnel. Training budget is duly allocated which is closely monitored in line with business goals.

2. Assessment: -This is performed because, as highlighted by the interviewees, a good number of entrants into the oilfield service industry are graduate trainees who have zero experience. These trainees are then assigned mentors or supervisors who keep a record of every kind of job operation the trainees perform and assess them. The crucial way the trainees gain knowledge is through hands-on troubleshooting and on-the-job training. For the maintenance personnel for example, the supervisor grades each technician based on whether he or she has met the standard, can perform jobs unsupervised and the experience required after a specified time frame. If the supervisor thinks the employee is good for promotion, he makes a requisition, together with a justification for the personnel to be promoted. However, for the field engineers and specialists, this process is more stringent and clear cut as they have a more

defined career path, which in many multinational companies, is monitored on a global scale or centrally.

3. Coaching: -Coaching is done as hands-on, to show the correct method and ascertain or evaluate the potential of the personnel being coached. Quality of work does come into account when doing maintenance. If an employee can deliver a high quality job but takes a longer period of time doing that, it is still acceptable. This suggests a tolerant and balanced view of grading employees, realizing the differences in employee work habits.

4. Cross training: - Employee roles are rotated so that employees have an all-round understanding of the operation and can even seamlessly sit in for an absent colleague. In the oilfield service industry, everything is almost certainly regarded as urgent and needs to be responded to very fast. Cross training breaks the disciplinary boundary. However, this rotation appears to concentrate or be limited to the field engineers and specialists as part of their career development path, and not so clear-cut with the maintenance team.

5. Appraisal: - Performance appraisals are regarded as constants in the industry. Usually performed on a quarterly or annual basis, appraisal affords the opportunity of discussing, if practically possible, employee development activities and gaps that need to be bridged. Hence, employee involvement is crucial in the appraisal process and outcome. All discussion are captured and tracked in the training matrix for each employee. Generally, appraisals give way to promotion or reward if merited. In cases where there are disagreements, it is escalated to the next level of dialogue according to laid down rules. It is both the employee and manager’s responsibility to get all the aspects of appraisal closed out without delay. The result of the exercise is made

accessible to both employee and manager at any point in their career with the organization. One great aspect of the exercise is the provision of comment facility by the person being appraised in order for the entire loop to be closed.

6. Accountability Matrix - The implication of this matrix as an empowerment strategy, as indicated by the interviewees, is that employees are rewarded based on their contribution in reducing and stopping non-conformances. The human resources department usually facilitates this reward although initiated by the relevant segment.

The function of the human resources (HR) department was also discussed to now encompass employee support and personnel planning, which are considered directly related to employee empowerment, impacting organization performance, hence the discussion on both areas below.

7. Employee support and personnel planning- Employee support caters for the needs of the employee, engaging the employee, and focusing on employee performance maximization while personnel planning is directed at driving business and resource optimization. The personnel department manages the training and competency of the employees depending on business demands, hence they work hand in hand with the different departments to ascertain training requirements and plan accordingly.

8. Employee empowerment evaluation –According to the interviewees, there is no real focus on evaluating how effective the empowerment process has been, especially from the perspective of the employee. Employee empowerment evaluation is usually mistaken for HR services audit, whose focus is on evaluating how responsive the HR has been in meeting the needs

of the employees. This implies that for the many organizations represented, the focus is on providing structure but not psychological empowerment assessment. Nevertheless, the HR department still engages with line management on the issues affecting the employees.

9. Employee participation in decisions making – This supposedly simple aspect was considered a sensitive subject. However, the interviewees described that employee opinion is sought on different fronts at different levels. Specifically, in managing their careers, employees undergo reviews at critical stages of their career to determine their aspirations and these are taken into consideration in their role change or function. Technology has also enabled effective participation even if it is anonymous. Furthermore, suggestions are welcomed although the last decision may still rest with the upper management.

10. Complaint or communications mechanism – In the past, employee complaints are aired through labour unions. Nowadays, organizations are moving away from adopting labour unions as they are considered an exceptionally financial drain on the company. Instead, there is in place a fair and transparent means of allowing the employee voice (complaints or suggestions) to be heard without fear of reprisal. Also, the personnel managers are trained to handle complaints without bias. Furthermore, there is an online system where complaints are posted anonymously and allow investigation without revealing employee details. The use of the official reporting lines e.g. supervisors and managers are encouraged before issues are escalated.

11. Access to and timely provision of information – With the location of the business units scattered all over the world, the business thrives on information. Dissemination is provided across

board and access is limited to only those employees with the company registered and monitored access. For employees who are not directly under the company hire, access to relevant information is given upon request and justification.

Challenges with Personnel Psychological Empowerment

There seems to be a great level of success in tracking the training and competence of the employee population. Nevertheless, all the interviewees described having some challenges with empowerment of employees in their organization. Two of the challenges are discussed below.

1. Growth in the number of employees – According to the interviewees, the number of new hires in the companies, which may continue to grow dramatically, poses a challenge due to the different employee categories. For the company's direct hire, their training and competency are under focus and managed at good levels. But the case is different for the employee population that fall under 'contract' or 'consultant' status, such as the maintenance team and other support functions. Hence, no matter how effective the empowerment strategies may be, it does not cater for everyone in the establishment.

2. Employee unique differences - Each person requires a unique set of empowerment, making it difficult to get everyone on the same plane. To manage this, career orientation review is performed for those employees that show excellent potential for growth and who fall within the direct employment of the company. The review, which is usually done at set intervals in the career life of the employee, is tailored towards understanding the strengths and weaknesses of the employee so as to map for them a career path that will give them a sense of a fulfilment.

4.2.2. Process

Interviewees disclosed that most of the processes, procedures and quality management systems adopted are passed on to them via the global expertise at their respective headquarters. However, upon reception, they are tailored to suit the local requirement since they are originally and usually designed based on the North Sea environment, which is the heart of oilfield service sector and with different climate considerations. The key service offerings have standard procedures regardless of company and so the differentiating factor is in the effectiveness of the process and not necessarily on the details of the process itself.

A few challenges are discussed which threaten the effectiveness of the process. These include

1. The sheer high number of processes - The field operation employees and the maintenance team are faced with tremendous amount of processes. Although the interviewees did not categorically say that processes are not good, but implied that duplication of steps or the huge similarities with the out-phased processes to the ones currently in use is causing a lot of the employees to stick to what they know best without regard to these new processes. They discussed the fact that when one drills down these numerous new processes, there is a struggle to see the new things added to the processes, and as such wonder why the change.

2. The integration of maintenance population – The field equipment maintenance population are most times not so integrated like the rest of the team and so it is a challenge with the introduction of processes. Although some companies are just starting to focus on this issue and review the entire structure by setting up career steps for the maintenance population, it is

coming after a very long huddle. Before now, there was no structured training programme or curriculum for the maintenance team; no clear entry-level positions and no progressive training programme whatsoever. Most of the integration process was all at the discretion of their supervisor, if any at all. The interviewees highlighted the fact that adoption of initiatives cannot be ultimately successful when this group of people are not recognized and managed carefully. Furthermore, the maintenance teams are mostly contractors making loyalty another issue. Nevertheless, the interviewees maintained that all the members of the maintenance team have a clear set of responsibilities, and their jobs fit together, enabling organizations to function effectively.

3. Generic nature of the processes introduced – Due to the different subdivisions or segments in some of the organizations, generic processes are rolled out. This makes adoption and achieving results a little lopsided as one or few segments continue to do better than the rest. The frustration results in the employee giving up on their efforts to make the process work. Until the design of the processes is tailored to each operation, the statistics in terms of performance will continue to be low. The good and encouraging thing, according to the interviewees, is that the people are hands on and they know their jobs. However, there is great room for improvement.

4. Demotivated Maintenance team population – It was gathered that because there is no standard or global recruiting process nor a structured career path developed for the maintenance team in their companies, this has led to the demotivation of some, with the others opting for offshore assignment, to earn more money by way of bonuses like their engineer counterpart. The lack of motivation has led to a great

deal of process adoption and implementation issues requiring urgent action.

4.2.3. Equipment

Findings from interviewees imply that most of the issues with equipment is related to maintenance management. The experts interviewed confirm that their organizations use a form of compute-based maintenance management system (CMMS). With CMMS, all the field operation equipment are required to be registered or given a unique identification, and a schedule for inspection and maintenance is programmed into the system based on the instruction manual that came with the equipment or with the international standard. When a maintenance or inspection is approaching or due, the CMMS generates and sends an advanced notification, of up to thirty days, depending on programming, thus allowing for proper planning. Depending on the focus of maintenance need, a particular maintenance type is adopted. For example, if focus is on the uptime of the equipment, a time-based maintenance is used. Time based maintenance depends on a certain milestone (e.g. run time) achieved by the equipment or certain checklist pointers or activities. The more progressive the milestone, the more advanced and aggressive the maintenance involved. The preferred and most widely adopted amongst the interviewees is the reliability-centred maintenance (RCM).

Main Challenges with Equipment Maintenance Management

1. Lack of passion in employees – Interviewees described a situation that suggests that most of the employees do not show any passion for the work, especially when it comes to equipment maintenance. According to the interviewees, the employees

prefer instead to change out parts completely rather than trouble shoot and perform maintenance, which is not a healthy trend for the organization. New parts cost money and so does repairs. Although the cost of new parts may be minimal in some cases, the culture of no maintenance due to lack of passion has robbed employees of valuable knowledge gained from the learning opportunity that maintenance presents, which may come in handy in the long run.

2. Limited experienced personnel with an eye for quality – It is not very common to hire fresh graduates for a good number of high positions in the maintenance field. Fresh graduates are hired mostly for some trainee programmes, while experienced personnel are required for the highly technical jobs. However, the experienced personnel are limited in the industry and so issue of retention arises.

3. Data reliability – Incorrect data input by employees can mean the difference between a successful job and a non-successful job. For example, if a piping data whose previous year dimension was recorded as 12mm thickness shows up today with a dimension record of 13mm, then something is wrong. That seeming insignificant difference can cause the whole rig to shut down leading to non-productive time.

4. Resource limitation due to Climate conditions - The weather in Malaysia or Asia in general is known for its usual monsoon season, limiting the extent and quality of work done during the changing climate conditions. Personnel allocation becomes priority, as it is a very dangerous period to send staff offshore, hence quality of work historically is affected at this time.

Key Performance Indicator for Equipment Maintenance -

Performance indicators for quality in equipment management vary from company to company. These include measures such as equipment failure rates (e.g. mean time between failures, MTBF), repairs (e.g. minimum time to repair, MTTR), the effectiveness of execution of work orders for equipment maintenance, how close to planned date the work orders were executed, and back log i.e. the amount of planned work not yet executed for any specific reason. Other measures include breakdown requests in the maintenance systems, uptime of the equipment, which is a key indicator for those service companies that are majorly tailored on asset management. To ensure compliance, these targets are worked into every employee scorecard and support is given to achieve them.

4.2.4. Operational service quality

The interviewees comment that the biggest challenge with the operational service quality is eliminating or keeping the non-productive time as low as possible as it constitutes a huge financial loss to the organization. A big part of this financial loss, according to the interviewees, is caused by employee non-adherence to procedure.

Reasons for Non-Adherence to Procedure

1. Communication of process to personnel - Market pressure to be certified on many fronts is driving the many processes that the companies have today and the implementation has not been of utmost success. The communication of these initiatives or certification process to the shop personnel especially, is not adequate, leading to substandard result. Furthermore, a situation where a third party company only checks and assesses

the process to see if there is something in place to cater for the aspect of certification of interest, regardless of whether it is working or not, is hurting the system. This encourages box ticking while the problem remains. Some of the interviewees cited that a lot of investment has been made to put things in place but most of them are not yielding the intended results because it is all about the big picture and not details.

2. Design of procedures - There are procedures in place for every operation but questions have arisen if the right people write these procedures due to language. Are the writers trained to write procedures? The shop personnel may claim ignorance or does not even understand some of the jargon used and so ends up doing things the best way he or she knows how to.

3. Lack of accountability - The lack of accountability, according to the feedback, is sometimes because of the operating environment where employees do not see the seriousness of their actions. One interviewee cited a case in point in his company (name withheld) to buttress this viewpoint. The interviewee discussed his company was cautious of reprimanding and hurting the feelings of others hence making enforcement of accountability a big dilemma unlike their competitors who prioritize accountability. To achieve tangible quality results, the interviewees maintained that even with a dedicated quality team whose responsibility includes ownership for checking implementation of the processes, quality must be seen as requiring collective effort.

Concept of Dedicated Quality Team -

There seems to be a subtle shift from the discussion of dedicated quality team to dedicated equipment maintenance team as though both are synonymous, implying that quality is viewed with a maintenance lens. Although the entire experts interviewed confirmed having a quality department, there wasn't a clear indication that the same dedication exists for maintenance. Moreover, there wasn't a robust quality career path mapped out for the quality team members when compared to the field engineers and specialists/technicians, a situation that makes for under utilization of potential. It is understood that field direct personnel are also expected to perform maintenance alongside field operations. However, within the organizations as a whole, it was gathered that there was a global or central quality team, which comprised experts from different discipline, technical background and individuals with impressive work experience on relevant projects.

When a project is decided, key personnel are selected from this global quality team to oversee key projects. Quality leads are appointed for each, and every equipment and accountability matrix is drawn as per project. Note that one lead may be the quality focal point for more than one piece of equipment. There is usually an auditor who is purely an accredited quality personnel in the team.

Adoption and Main Reasons of Quality Initiatives-

All the interviewees confirmed their organization had one form of quality system or another, which stems mostly from TQM. The most adopted methodology for problem solving as gathered from the interviewees is DMAIC. DMAIC stands for define, measure, analyze, improve and control. It is a systematic approach with logical steps starting from defining the problem, knowing your current state, and using facts (data) to measure and analyze the problem before making the improvements. Once the improvements have been made, the last critical step is to control and sustain the implementation so that the improvements won't fall back to the old state. There are several tools within the company to address the different DMAIC stages.

The reasons for the adoption of quality is diverse and not limited to market pressure, trend, customer expectation, competition, and cost. However, three key reasons were given for adoption of quality initiatives. These are

1. Non-productive time – Since this has a potential to result in huge financial loss both for the customer and organization, the organizations adopt different initiatives to enable them to tackle the issue. The reports are run every month or at the end of the projects and reviewed by the management to capture core reason for non-productive time.

2. Customer satisfaction –The customers are the greatest focus hence their requirements and satisfaction is priority. The companies therefore, in as many ways as they can, show and reassure the customers that their million dollar projects can be handled without more than the budgeted cost so as not to risk loosing the project contract to their competitors.

3. Competition – Even though the interviewees maintained that they share best lessons learnt on projects within the industry, the unique quality initiatives which enable them do it right the first time are not usually shared as this gives them an edge in contract bidding to gain market share more than competition.

Measuring Quality across the Organization

The interviewees indicated having performance indicators that reflect their focus on customer needs. Although non-productive time was gathered to be a measure with the utmost focus and is used for operational efficiency, quality is tracked with some key client indicators that include

1. Compliance - This is the ability to meet product and service specifications. Employees are empowered to stop any non-compliant job regardless of stakeholder push.

2. Customer satisfaction - This is tracked via customer feedback. Complaints or official report (written or verbal complaints) from customers are monitored. A customer satisfaction report form is given out to the customer after every job and this is reviewed after and before the next job, especially if the next job in view is for same client.

3. Timeliness - It is the ability to mobilize technically acceptable manpower and equipment to job site upon request for services, within contract terms and conditions. The time taken to deliver the project is also compared with planned time.

Impact of Non-Compliance to KPI

1. On stakeholder – Financial loss is largely the impact for the stakeholders. For example, missing out on deadline for first oil delivery at a time when the oil price is high results in financial loss for stakeholders.

2. On Organization – Loss of contract, which translates to loss of market share, hence also financial loss, is one huge implication of non-compliance to the affected organization.

Tools for Communication of Quality Issues

1. Quality alerts – These alerts trigger some form of action, mostly investigation. If the alert bothers on particular equipment, investigation is carried out to check if such equipment is in the current inventory and if so, the design criteria and likelihood of same manufacturers of affected equipment are reviewed. Experts on such areas are usually engaged to investigate and re-assess.

2. Reporting Database – There is a quality-reporting database to capture any quality non-compliance, and its related dollar value amongst other things. Access to the database is given to the relevant quality personnel and has potential of being linked to other relevant vendor management sites, enabling the company to effectively perform vendor selection. The database allows for standardization and consistency due to information sharing on this database.

4.2.5. Operational Service Efficiency

Operational efficiency takes care of both cost and manpower and is managed differently by the different companies, although the purpose seems to be same. The responses gathered from the interview describing the diverse methods for achieving operational service efficiency are highlighted below.

1. Via Contract Agreement - One of the ways to ensure cost efficiency is via signed contract agreements. A negotiated contract locks in the price rate of equipment and manpower for that period and consequently optimizes time. Without a contract, however, each job operation requires an issuance of purchase order, which is affected by price fluctuations.

2. Via Internal Global Support Team - Since most of the multinational companies are headquartered outside Malaysia, there is a benefit of overseas expert support team. Any issue that cannot be resolved is referred to the global expert specialists who are meant to help all operators whenever there is any issue. The expert specialist advises on the best method or best practice to resolving an issue and actions are executed as per their recommendation. This saves cost of hiring external expertise and more so, keeps skill and knowledge expertise within the company as a competitive edge.

3. Via Weather Forecasting Process - Asian region is prone to climate change, specifically the monsoon seasons, unlike any other region in the world. Even with proper manpower planning which can reduce cost, managing manpower during this period is a crucial challenge. A minimum number of crew is sustained offshore at that period to minimize the risk and make for easier evacuation in case of any emergency. The weather forecasting plan ensures maintenance is done before the monsoon season but sometimes companies are faced with no alternative than to increase working hours, which inadvertently increases cost.

4. Via Employee Planning and Optimization - Assigning the right people to the right roles optimizes performance, as employees are managed with respect to activity cycles. The focus is to align field direct employees to spend less time in the base location and performing critical tasks only if unavoidable, and spend more time at the well site or on day-off or vacation. Essentially, the workforce is separated into two groups - those delivering products and services directly to customers, and those supporting that process. Optimizing support by reassigning base tasks reduces required base days, increases redeployment opportunities, and improves work-life balance by providing relief to the field population with days off and vacation.

5. Via Direct Empowerment to Stop Unsafe Acts – Because safety is usually equated with quality in the industry, the interviewees discussed that employees are directly empowered to stop unsafe acts. To capture unsafe acts and subsequently quality issues, a database is in place for employees to input their suggestions as part of their duties. These inputs are often reviewed for award purposes to employees and implementation of outstanding contributions.

6. Via Translating of Business Strategy Into Workforce Tasks – With the highly dynamic environment in which the industry operates and considering the different disciplines and technologies in the operations, it can be difficult to predict the needs of field population at a specific time. This could mean that managers struggle to have the resources for a field operation without either being short on people or excess. Both scenarios are highly costly and affect the utilization of the field direct population. Thus with a proper forecast of people needs versus activity, managers could better plan their business, including such as training time, recruiting numbers, and employee days off.

The interview was concluded when the degree of convergence among the experts' opinions was quite high, yielding a rich context for consideration of incorporation in the next step of the questionnaire survey and for result interpretation.

4.3. Result and Analysis of Questionnaire Survey

4.3.1. Respondent Profile

Although a total of 230 questionnaires were administered manually to reduce non response rate (DeLeeuw and DeHeer, 2002), 190 completed copies were returned indicating an 80% return rate. According to DeLeeuw and DeHeer (2002), response to survey has been decreasing over the years partly due to an increase in non contacts and partly due to increase in refusals. For the petroleum industry in particular, Mellat-Parast et al. (2007) highlights that conducting surveys in the petroleum industry could be a challenge and this could be due to reasons, which include but not limited to the nature of organization. Out of these returned 190 copies, 39 were discarded due to incompleteness and unengaged responses thus reducing the number of respondent workable data to 151. However, this sample size of 151 was still considered adequate to employ SEM. According to Zainudin (2014) a minimum sample size of 150 is required for seven or less latent constructs in a model with each construct having more than three items.

From the data received, a significant 111 respondents (73.5% of the respondents) were male respondents while the remaining 26.5% (40) were female (Figure 4.0).

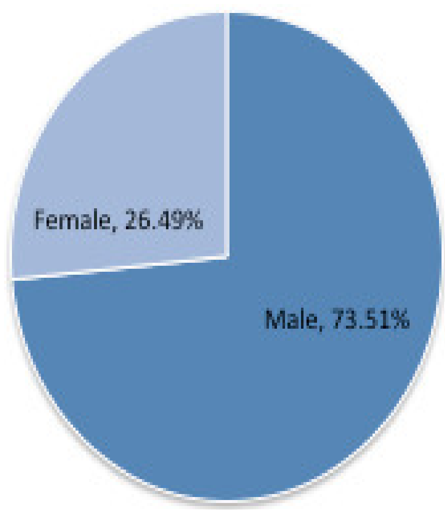


Figure 4.0: Gender distribution of respondents

This significant gender dispersion as seen in the percentage suggests that the oilfield service industry has in its employment more male than the female counterparts. According to the International Labour Organization (2012), the oil and gas industry has not succeeded in hiring a large number of qualified women workers and this still persists to date. Although there is today increased visibility of women in the industry, the challenges of recruiting women stem predominantly from the male-focused culture and practices that permeate many aspects of organizational life in the industry, including demographic composition, assumptions, values and every day practices (Ely and Meyerson, 2006). The distribution of the respondent nationalities is shown in Figure 4.1 below.

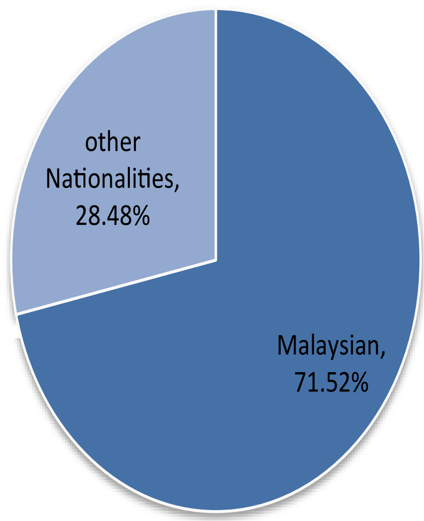


Figure 4.1: Nationality distribution of respondents

Although this study was restricted to companies in Malaysia, the companies surveyed were multinational in makeup and so other nationals were represented in the distribution. A total of 108 (71.52%) Malaysians versus 43 non-Malaysians (28.48%) gives a ratio of 3:1, replicating the Malaysian government preference and drive on ethical preference in engineering establishments (Bureau of Economic Energy and Business affairs, 2011). According to Bureau of Economic Energy and Business affairs (2011), a foreign engineering firm may establish a commercial presence, subject to meeting government requirements on Malaysian citizen participation. More so, to obtain temporary licensing for a foreign engineer, the Malaysian company often must demonstrate to the country’s board of engineers that it cannot find a Malaysian engineer for the job. This situation is not only peculiar to Malaysia but also obtainable in many developing countries as a means of knowledge transfer strategy (International Labour Organization, 2012).

The age distribution of the respondents showed that the 31 - 40yrs age bracket contained the largest number of respondents (30.46%), Figure 4.2.

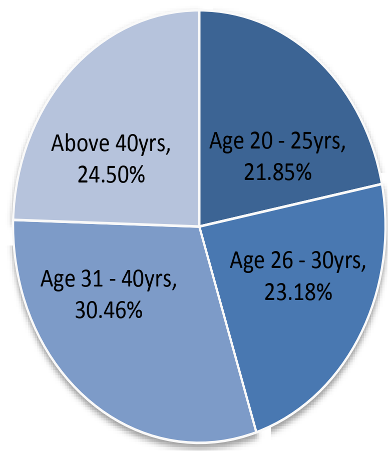


Figure 4.2: Age distribution of respondents

Respondent population of ‘above 40yrs’ closely follows the respondent age population of between 31 – 40yrs. This result puts the percentage of aging population to 55% – i.e. population that will be retiring or approaching the average energy industry retirement age of 55yrs within seven to ten years. Furthermore, the number of respondents, who have spent less than 5yrs seniority in the industry, was slightly above 40% of the entire population as shown in Figure 4.3. This suggests a relatively high number of young professionals and a probable focus by the organization on recruitment of new employees.

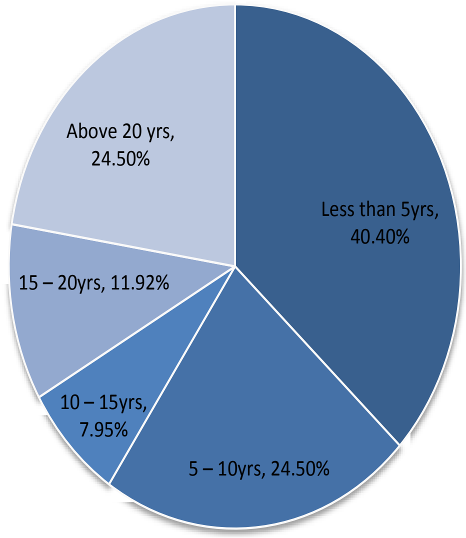


Figure 4.3: Work Seniority of Respondents

This focus on recruitment of young talented employees is perhaps linked to the general characterization of the millennial generation as adept at multitasking, and technologically savvy, (Beard et al., 2007), having a higher motivation to transfer what they learn during training back to their jobs, and having a higher learning-goal orientation – a concept defined as a person's focus on acquiring knowledge for the sake of learning itself rather than just performing (Tyler, 2007). As commented by the International Labour Organization (2012), the oil and gas industry can leverage on the preferences and motivational patterns among young people of this generation, through training courses designed to quickly advance the necessary skills. An overview of the demographics is tabulated in Table 4.2.

Table 4.2: Respondents' demographics

Age bracket of respondents (years)	Race of respondents					
	Male	Female	Malaysian		Non-Malaysian	
			Male	Female	Male	Female
20 –25	22	11	21	10	1	1
26 –30	19	16	14	13	5	3
31 –40	38	8	22	7	16	1
Above 40	32	5	18	3	14	2
Total	111	40	75	33	36	7
Seniority	Male	Female	Role (Field Engineers		Role (Field specialist)	
			Male	Female	Male	Female
< 5yrs	37	24	19	20	18	4
5 –10 yrs.	28	9	22	6	6	3
10 –15 yrs.	20	3	6	1	14	2
15 –20 yrs.	14	4	6	3	8	1
> 20 yrs.	12	0	7	0	5	0
Total	111	40	60	30	51	10

4.3.2. Descriptive Analysis

A standard 10-point Likert scale distributed from 'strongly disagree' to 'strongly agree' was used for this survey so that the data, according to Zainudin (2014), would be "more independent and meet requirement for parametric analysis" (p.17) thus allowing for a more detailed evaluation. Moreover, most people found it easier to think in averages; thus 10 equal 100 percent, 9 would equal 90 percent. To understand these figures, a score above 75% to 100% would be interpreted to mean that all respondents strongly agreed with every statement on the respective constructs. A score above 50% to 75% implies that on average, the respondents moderately agreed with the statements on the constructs and a score 50% or below implies that respondents neither agreed nor disagreed with the various statements. See appendix K2 for all descriptive analysis.

4.3.3. Reliability Analysis

The reliability of the proposed measurement structure is indicated by the Cronbach (1951) alpha value, α. This value, the standard of which is alpha> 0.7 (Nunnally, 1978), is summarized and presented in table 4.5 and ranged from 0.7 to above 0.9 for each of the constructs indicating that the measures used in the survey actually measure the antecedents of the constructs in a meaningful and consistent way. These reliability coefficients according to Hair, et al. (1998) are considered to be acceptable.

According to Zainudin (2014), the number of items employed to measure a latent construct should be a minimum of four (4) to avoid 'model identification problem' during the analysis part. For detailed reliability output, refer to appendix K3. Table 4.3 below summarizes the reliability statistics.

Table 4.3: Reliability statistics

Reliability Statistics		
Constructs	Cronbach alpha	N of items
Empowerment	0.857	4
Meaningfulness	0.729	5
Responsibility	0.804	6
Accountability	0.716	4
Mindfulness	0.776	6
Competence	0.785	5
Choice	0.881	5
Impact	0.840	4
Operational quality	0.885	6
Process	0.724	4
Equipment	0.811	4
Operational efficiency	0.933	4

4.3.4. Factor Analysis

The Factor analysis and regression analysis performed in this study was done in one step using the structural equation modelling (SEM) technique as it was equivalent and encompassed both. More so, SEM is a multivariate technique that allowed us to represent the way constructs relate to measured indicator items, as well as to one another (Hair, et al., 2006, p.719). The Kaiser-Meyer-Olkin (KMO) test, which is a measure of sampling adequacy obtained for each of the measures, was above 0.7, far greater than 0.5 which is the barest minimum (see appendix K2). Criteria for KMO suggest that a value ranging from 0.5 to 0.7 is mediocre, 0.7 to 0.8 is good, 0.8 to 0.9 is great and values >0.9 are superb (Hair et al., 2006). All Factor analysis performed ensured that the measures representing each construct are related to one component before progressing to the next step. This was achieved with the exclusion of items with poor factor loadings less than 0.4. Criteria is factor loadings >0.5= good/strong. The refined measurement scale showed good validity and reliability.

4.3.5. Structural Equation Modelling

To better examine the model and answer the research questions, the model is broken down and presented in two parts, namely employee psychological empowerment antecedents model (model A) and critical success factors model (model B). The first part, model A, is shown in Figure 4.4 and represents the antecedents of empowerment, while the second part, model B, shown in Figure 4.5 depicts the full model. Both models (Figure 4.4 and Figure 4.5) are recursive in nature. This means that the paths between constructs all proceed from the antecedent construct to the outcome construct (empowerment) without any feedback loops or arrows working in an opposite direction.

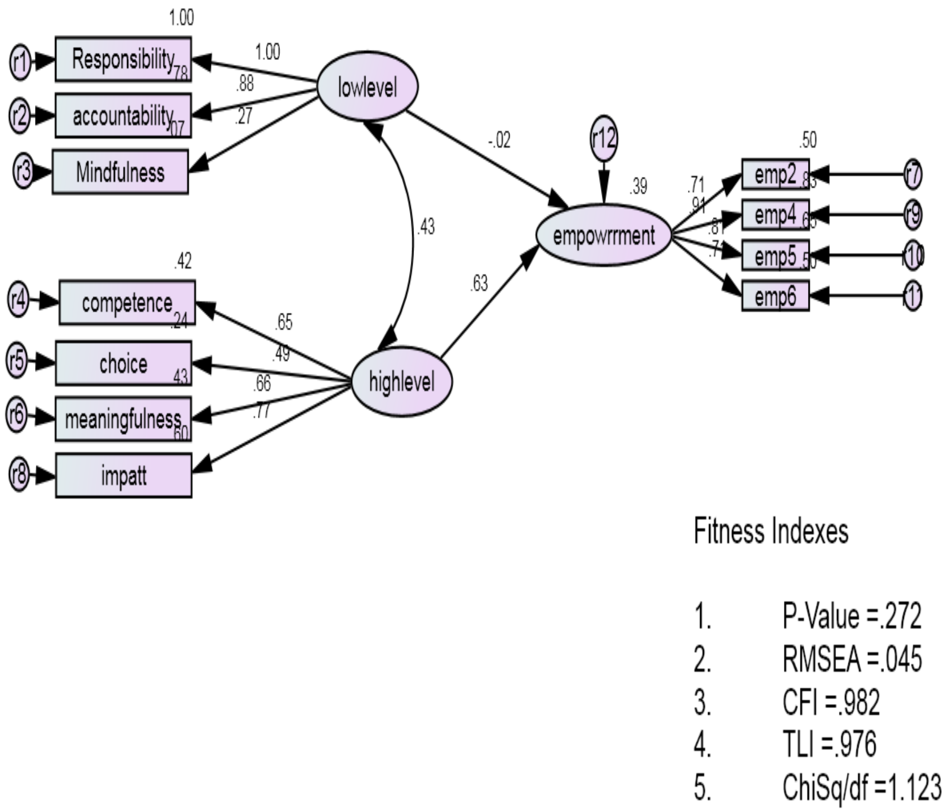


Figure 4.4: Model A - Psychological empowerment antecedent association

Examining model A, which represents an attempt to answer the first research question on the significant antecedents of psychological empowerment in the oilfield service industry, the latent variable, empowerment, is predicted by two latent predictor variables (low level and high level antecedents); each of which has three and four indicators respectively. It was found that the coefficient of the relationships for low level (responsibility, accountability and mindfulness) and high level (choice, competence, meaningfulness and impact) are -0.04 and 0.62 respectively, suggesting that the high level antecedents have a stronger impact while the low level is not so significant.

The directed arrows from the low level to the observed variables (responsibility, accountability and mindfulness) indicate the loadings of the variable on the proposed latent factor. Therefore, a one standard deviation increase on the low level is associated with a 0.88 standard deviation increase on the accountability. Note that in simple regression, a standardized regression coefficient is the same as the correlation. Thus, we could also say that the low level correlates 0.88 with accountability, 1.00 with responsibility and 0.27 with mindfulness respectively. Similar explanation is applied to the remaining variables.

Furthermore, the chi-square ($\chi 2$) test yielded a value of 46.025 and a corresponding significant high p-value of 0.272, being evaluated with 41 degrees of freedom. The model has 66 sample moments calculated as 11*11/2 + 11/2 = 66 sample moments. These reflect 55 measures of covariance and 11 measures of variances.

The fitness indexes, as depicted in the model A shown earlier (Figure 4.4), supports a good and acceptable fit with p-value higher than 0.05 and root mean square error of approximation (RMSEA) test of 0.045, which is below the 0.05 value of best model fit criteria. The rule-of-thumb for RMSEA suggests RMSEA<0.05 as a good fit while RMSEA<0.08 is deemed acceptable. Note also that Comparative Fit Index (CFI) value obtained is 0.982, which also indicates a very good fit. Rule of thumb for CFI suggests >0.90 as good while CFI >0.95 as a very good fit. The high level variables with a strong regression weight of 1.093 as shown in Table 4.4 below suggests best indicators of empowerment, supporting developed hypothesis H_1. The high level antecedents of empowerment have high positive association with personnel psychological empowerment.

The critical ratio (C.R) as shown in Table 4.4 is the estimate divided by the standard error. Values greater than 2 tend to indicate an estimate that is statistically significantly different from zero at the 0.05 levels reflected in the P-values.

Table 4.4: Regression weights of Model A

			Estimate	S.E.	C.R.	P	Label
Empowerment	<---	Low level	-.021	.142	-.148	.882	
Empowerment	<---	High level	1.093	.351	3.115	.002	
Responsibility	<---	Low level	1.000				
Accountability	<---	Low level	.892	.137	6.531	***	
Competence	<---	High level	1.000				
Choice	<---	High level	1.114	.348	3.203	.001	
Meaningfulness	<---	High level	.985	.245	4.024	***	
Impact	<---	High level	1.580	.358	4.417	***	
Mindfulness	<---	Low level	.273	.128	2.126	.033	

The regression weight and significant value (p-value) obtained for low-level antecedents gives -.021 and 0.882 respectively. This negative association suggests that hypothesis $H_{2:}$ The low level antecedents of empowerment have positive association with personnel psychological empowerment is not supported by the results obtained, contradicting the feedback from unstructured interview. Recall the low level consists of responsibility, accountability and mindfulness. Nevertheless, accountability tends to be significant on its own in relation to empowerment.

Further interactions of the variables performed using STATA version 12 showed the following observations. Interacting Responsibility with RRole (role), where RRole was generated as 1= Field Engineer and 0= Field specialists, result (Table 4.5) suggests that mindfulness and choice are statistically significant at the 1% level with competence statistically significant at the 10% level.

Table 4.5: Interaction of Responsibility and Role

Source	SS	df	MS
Model	73.7960005	18	4.09977781
Residual	84.0698935	132	.636893133
Total	157.865894	150	1.05243929

Number of obs	= 151
F(18, 132)	= 6.44
Prob > F	= 0.0000
R-squared	= 0.4675
Adj R-squared	= 0.3948
Root MSE	= .79806

Empowerment1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Sex	-.0099283	.1639748	-0.06	0.952	-.3342867	.3144302
Age1	.2075283	.384187	0.54	0.590	-.5524315	.9674881
Age2	.1843266	.3536018	0.52	0.603	-.5151327	.8837858
Age3	.2417983	.3072707	0.79	0.433	-.3660135	.8496101
Age4	0	(omitted)				
Sen1	.0380796	.2873851	0.13	0.895	-.5303965	.6065557
sen2	-.0830532	.2441129	-0.34	0.734	-.5659327	.3998263
Sen3	0	(omitted)				
Sen4	.0056224	.3284148	0.02	0.986	-.6440145	.6552594
Sen5	-.3762589	.3659113	-1.03	0.306	-1.100068	.3475499
RRole	2.18015	1.274809	1.71	0.090	-.3415485	4.701848
SStaff	.1025338	.1065691	0.96	0.338	-.1082704	.3133379
Mindfulness1	.4013239	.1049838	3.82	0.000	.1936555	.6089923
Responsibility1	.0238325	.2024299	0.12	0.906	-.3765938	.4242588
ResponsibilityRRole	-.2767544	.1761132	-1.57	0.118	-.6251237	.0716149
accountability1	.171956	.1706757	1.01	0.316	-.1656574	.5095695
choice1	.2649441	.0643021	4.12	0.000	.1377482	.3921401
meaningfulness1	.0508885	.1122332	0.45	0.651	-.1711199	.272897
competence1	.1930122	.1076749	1.79	0.075	-.0199794	.4060037
impact1	.1207275	.0924647	1.31	0.194	-.0621767	.3036317
_cons	-1.841802	1.528761	-1.20	0.230	-4.865842	1.182238

This interaction of responsibility with role is not statistically significant having a p-value of 0.118, indicating that the effect of responsibility on empowerment is not statistically different between the engineers and the specialists. F-Stat indicates the joint significance, which means that the variables on the right hand side (RHS) together are able to predict empowerment well – at the 1% significance level.

Interacting Mindfulness with RRole, where RRole was generated as 1= Field Engineer and 0 = Field specialists, result (Table 4.6) suggests that role (i.e. Field engineer or Field specialist role) plays a part in feelings of empowerment of the personnel.

Table 4.6: Interaction of mindfulness and Role

Source	SS	df	MS
Model	74.3632797	18	4.13129332
Residual	83.5026143	132	.632595563
Total	157.865894	150	1.05243929

Number of obs	=	151
F(18, 132)	=	6.53
Prob > F	=	0.0000
R-squared	=	0.4711
Adj R-squared	=	0.3989
Root MSE	=	.79536

Empowerment1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Sex	-.0135413	.1634546	-0.08	0.934	-.3368707	.3097881
Age1	.236508	.3839137	0.62	0.539	-.5229113	.9959273
Age2	.2235687	.3534851	0.63	0.528	-.4756599	.9227973
Age3	.3084304	.3078708	1.00	0.318	-.3005686	.9174293
Age4	0	(omitted)				
Sen1	.0826765	.28855	0.29	0.775	-.4881038	.6534569
sen2	-.0902058	.2423117	-0.37	0.710	-.5695224	.3891108
Sen3	0	(omitted)				
Sen4	.0851303	.3309214	0.26	0.797	-.5694649	.7397255
Sen5	-.3721045	.364505	-1.02	0.309	-1.093131	.3489224
RRole	2.482564	1.255035	1.98	0.050	-.0000193	4.965147
SStaff	.0871015	.1069066	0.81	0.417	-.1243703	.2985732
Mindfulness1	.560081	.1302787	4.30	0.000	.3023768	.8177852
Responsibility1	-.1212675	.1746788	-0.69	0.489	-.4667994	.2242643
MindfulnessRRole	-.3013875	.1638604	-1.84	0.068	-.6255196	.0227446
accountability1	.1452192	.1690147	0.86	0.392	-.1891086	.479547
choice1	.2560702	.0637837	4.01	0.000	.1298997	.3822407
meaningfulness1	.0481241	.111641	0.43	0.667	-.1727127	.268961
competence1	.1815108	.1067124	1.70	0.091	-.0295769	.3925985
impact1	.1360133	.0929864	1.46	0.146	-.047923	.3199496
_cons	-1.7788	1.400337	-1.27	0.206	-4.548805	.9912052

Furthermore, mindfulness and choice are still statistically significant at the 1% level while competence is significant at the 10% level. Also the interaction, although significant at the 10% level, has a negative (–ve) coefficient. This indicates that the effect of mindfulness on empowerment is more important for Field specialists than Field engineers. Overall however, Field engineers are more likely to feel empowered than field specialists, this effect is statistically significant at the 5% level.

Interacting Mindfulness with Sex, where Sex was generated as 1= Male (men) and 0 = Female (women), result (Table 4.7) suggests that on average, women are more empowered than men.

Table 4.7: Interaction of mindfulness and sex

Source	SS	df	MS
Model	76.0606828	18	4.22559349
Residual	81.8052112	132	.619736449
Total	157.865894	150	1.05243929

Number of obs	=	151
F(18, 132)	=	6.82
Prob > F	=	0.0000
R-squared	=	0.4818
Adj R-squared	=	0.4111
Root MSE	=	.78723

Empowerment1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Sex	-3.174965	1.28839	-2.46	0.015	-5.723528	-.6264023
Age1	.2179963	.3786295	0.58	0.566	-.5309702	.9669628
Age2	.1601544	.3487177	0.46	0.647	-.5296436	.8499525
Age3	.2522007	.3030682	0.83	0.407	-.3472981	.8516995
Age4	0	(omitted)				
Sen1	.0560829	.2835545	0.20	0.844	-.5048159	.6169817
sen2	-.1664632	.2390467	-0.70	0.487	-.6393213	.3063949
Sen3	0	(omitted)				
Sen4	-.006184	.3238853	-0.02	0.985	-.6468612	.6344933
Sen5	-.4423764	.3597546	-1.23	0.221	-1.154006	.2692537
RRole	.2195462	.1523695	1.44	0.152	-.0818557	.5209481
SStaff	.1099136	.1049524	1.05	0.297	-.0976926	.3175199
Mindfulness1	.1248059	.1560591	0.80	0.425	-.1838946	.4335063
MindfulnessSex	.4121018	.1656095	2.49	0.014	.0845099	.7396938
Responsibility1	-.1401208	.1727256	-0.81	0.419	-.4817891	.2015475
accountability1	.1333929	.1673087	0.80	0.427	-.1975601	.464346
choice1	.2326906	.0637707	3.65	0.000	.1065459	.3588354
meaningfulness1	.0496717	.1104397	0.45	0.654	-.168789	.2681323
competence1	.1895271	.105729	1.79	0.075	-.0196153	.3986695
impact1	.1522588	.0925365	1.65	0.102	-.0307875	.3353051
_cons	1.735621	1.323952	1.31	0.192	-.8832866	4.354529

This effect is statistically significant at the 5% level. However, the effect of being mindful on empowerment is larger for men than women—and this effect is statistically significant at the 5% level. Hence, if initiatives that encourage mindfulness are introduced, men will feel more empowered.

Interacting Responsibility with agea30, where agea30 was generated as agea30=1 if Age 3=1 or Age 4=1 and 0 if Age 1=1 or Age 2=1, result (Table 4.8) suggests that employees above age 30 years do not feel especially empowered overall when compared to the those employees below age 30. However, the change in the empowerment is more or larger for those above 30 when more responsibility is introduced.

Table 4.8: Interaction of Responsibility and Age above 30 years

Source	SS	df	MS
Model	74.0599805	16	4.62874878
Residual	83.8059135	134	.625417265
Total	157.865894	150	1.05243929

Number of obs =	151
F(16, 134) =	7.40
Prob > F =	0.0000
R-squared =	0.4691
Adj R-squared =	0.4057
Root MSE =	.79083

Empowerment1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Sex	.0004539	.1607851	0.00	0.998	-.3175511	.3184588
agea30	-2.179213	1.194845	-1.82	0.070	-4.542407	.1839814
Sen1	0	(omitted)				
sen2	-.1023582	.2137568	-0.48	0.633	-.5251319	.3204156
Sen3	-.0474192	.2750602	-0.17	0.863	-.5914404	.496602
Sen4	-.2095727	.2941867	-0.71	0.477	-.7914226	.3722773
Sen5	-.6480609	.3261914	-1.99	0.049	-1.293211	-.0029113
RRole	.191488	.1525457	1.26	0.212	-.1102208	.4931968
SStaff	.1138251	.1053259	1.08	0.282	-.0944912	.3221414
Mindfulness1	.4506714	.10474	4.30	0.000	.2435138	.6578289
Responsibilityage	.3088312	.162573	1.90	0.060	-.0127099	.6303722
Responsibility1	-.3317057	.2063087	-1.61	0.110	-.7397484	.076337
accountability1	.1484577	.1660394	0.89	0.373	-.1799393	.4768548
choice1	.263091	.0630475	4.17	0.000	.138394	.387788
meaningfulness1	.0396119	.1104422	0.36	0.720	-.1788236	.2580473
competence1	.1725071	.1047548	1.65	0.102	-.0346796	.3796939
impact1	.0903479	.091415	0.99	0.325	-.090455	.2711508
_cons	1.155889	1.127764	1.02	0.307	-1.074631	3.386409

Interacting accountability with agea30 (i.e. Age above 30) result (Table 4.9) suggests younger employees generally feel more empowered but once accountability is introduced the employees above age 30 years feel more empowered.

Table 4.9: Interaction of accountability and age above 30yrs

Source	SS	df	MS
Model	74.8879138	16	4.68049461
Residual	82.9779803	134	.619238659
Total	157.865894	150	1.05243929

Number of obs	= 151
F(16, 134)	= 7.56
Prob > F	= 0.0000
R-squared	= 0.4744
Adj R-squared	= 0.4116
Root MSE	= .78692

Empowerment1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Sex	-.0052711	.1600616	-0.03	0.974	-.321845	.3113028
agea30	-2.494271	1.161365	-2.15	0.034	-4.791249	-.1972933
Sen1	0	(omitted)				
sen2	-.0716975	.2138326	-0.34	0.738	-.4946211	.3512262
Sen3	-.0202568	.2739252	-0.07	0.941	-.5620332	.5215196
Sen4	-.2083582	.292729	-0.71	0.478	-.7873252	.3706087
Sen5	-.6286807	.3246831	-1.94	0.055	-1.270847	.0134859
RRole	.2036155	.1518808	1.34	0.182	-.0967782	.5040092
SStaff	.12037	.1048613	1.15	0.253	-.0870274	.3277674
Mindfulness1	.4713944	.1055444	4.47	0.000	.262646	.6801429
choice1	.2524603	.0622153	4.06	0.000	.1294092	.3755113
Responsibility1	-.182128	.1729998	-1.05	0.294	-.5242915	.1600354
accountability1	-.0215901	.1756285	-0.12	0.902	-.3689526	.3257724
accountabilityage	.3549889	.1590475	2.23	0.027	.0404207	.6695572
meaningfulness1	.0375864	.1098826	0.34	0.733	-.1797422	.254915
competence1	.1739247	.1042262	1.67	0.098	-.0322165	.380066
impact1	.0829369	.0911747	0.91	0.365	-.0973907	.2632645
_cons	1.244896	1.101647	1.13	0.260	-.9339707	3.423763

This result supports Spreitzer (1995) study which showed that higher ranking and higher educated employees reported more feelings of empowerment. In mirroring specialists and engineers in the oilfield service environment, the engineers feel more empowered than their specialist counter parts.

The results of structural model B (Figure 4.5), which represents the whole model, suggests that employee psychological empowerment, process and equipment all have a part to play in operational quality, however, employee psychological empowerment has the greatest impact with a significant value of 0.032. This is followed by equipment with p-value of 0.050, and process with 0.106 respectively (Table 4.10).

The fitness indexes depicted in the model B (Figure 4.5) supports a good and acceptable fit supported by the p-value and the RMSEA. Although the root mean square error of approximation (RMSEA) test of 0.073 is above the 0.05 value of best model fit criteria, it is still within the acceptable range.

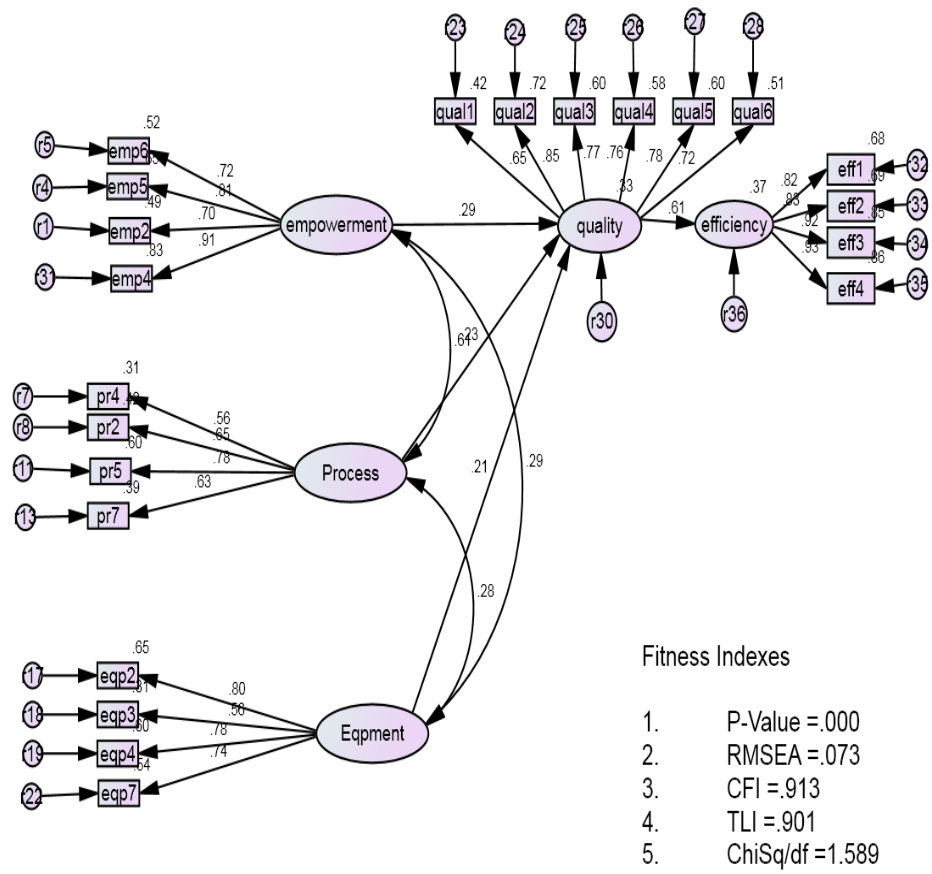


Figure 4.5: Model B- Impact of critical success factors on operational service quality

Note also that Comparative Fit Index (CFI) value obtained is 0.913, which also indicates a good fit.

The regression table of Model B is shown in Table 4.10

Table 4.10: Regression weights on Model B

			Estimate	S.E.	C.R.	P	Label
Quality	<---	Empowerment	.279	.130	2.148	.032	
Quality	<---	Process	.188	.116	1.617	.106	
Quality	<---	Equipment	.220	.112	1.958	.050	
Efficiency	<---	Quality	.786	.150	5.252	***	

The three stars (***) as seen in Table 4.10 signify a p-value less than 0.001. P values are statistically significant if *p*-value is less than 0.05. The table above indicates that operational quality association with operational efficiency showed a very significant p-value with a high estimate of 0.786, which is very close to 1 and explaining about 61% of operational efficiency. The closer to 1 (one) the regression rate is, the higher the correlation, which means a high impact on operational efficiency. This result provides evidence of the relationship and supports the literature that efficiency of service operation is impacted by quality. This is also supported by the critical ratio (C.R), obtained by dividing the estimate by the standard error. Values above 2 suggest an estimate that is statistically significantly different from zero at the 0.05 levels. This supports hypothesis H_4 that says Operational Service Quality has a positive association with Operational Service Efficiency.

The low R-squared value of 0.327 and 0.373 for quality and efficiency respectively is expected as the field of study explores human perceptions (psychological empowerment). As indicated by Frost (2013), any field that attempts to investigate human behaviour, such as psychology, typically has R-squared values lower than 50% (0.5) since humans are simply harder to predict than, say, physical processes. Furthermore, since the predictors are statistically significant predictors in spite of the low R-squared, important conclusions could still be drawn about how changes in the predictor values are associated with changes in the response value. Regardless of the R-squared values, the significant coefficients still represent the mean change in the response for one unit of change in the predictor while holding other predictors in the model constant. In general, the field of study plays a part as well. R-squared is a statistical measure of how close the data are to the fitted regression line and ranges between 0 and 100%. Note that 0% indicates that the model explains none of the variability of the response data around its mean while 100% indicates that the model explains all the variability of the response data around its mean. In general, the higher the R-squared, the better the model fits the data.

The overall survey result suggests that personnel are the greatest assets in the pursuance of improved operational quality service, interacting with equipment maintenance and process. People, according to Simoes et al. (2010) are the most important resource in maintenance. According to Ljungberg (1998), the effectiveness of any maintenance system is very much dependent on the competency, training, and motivation of the overall human factor in charge of the maintenance system. Hence, maintenance activities should be considered a main business process. This view is supported by Pinjala et al. (2006) and Rosqvist et al. (2009) who challenges the prevalent view that maintenance is a subordinate activity, concluding in favor of its consideration as a business strategy. This suggests that the performance of any quality effort significantly depends on these psychological empowerment elements which activates the human mind and drive human effort (Arca and Prado, 2008, Eti et al., 2006).

Below is summary of results from evaluating the hypothesis.

Table 4.11: Hypothesis 1 evaluation

Hypothesis 1	
H_1	The *high level antecedents have a positive association with employee psychological empowerment
H_0	The high level antecedents do not have a positive association with employee psychological empowerment
Results show that the high level antecedents are the strongest predictors of employee psychological empowerment (see Table 4.4). Therefore, H_1*= supported.*	

*High level antecedents =meaningfulness, competence, impact and choice.

Table 4.12: Hypothesis 2 evaluation

Hypothesis 2	
H_2	The *low-level antecedents have a positive association with employee psychological empowerment.
H_0	The low level antecedents do not have a positive association with employee psychological empowerment
Results show that the low level antecedents on their own cannot sufficiently predict employee psychological empowerment (see Table 4.4). Therefore, H_2*= not supported.*	

*Low level antecedents =responsibility, accountability and mindfulness

Hypothesis 3 is broken into 3a, 3b and 3c to better report their respective significance.

Table 4.13: Hypothesis 3a evaluation

Hypothesis 3a	
H_{3a}	Employee psychological empowerment has a positive relationship with operational service quality.
H_0	Employee psychological empowerment does not have a positive relationship with operational service quality.
Results show that employee psychological empowerment has a strong association with operational quality (see Table 4.10). Therefore, H_{3a}*= supported.*	

Table 4.14: Hypothesis 3b evaluation

Hypothesis 3b	
H_{3b}	Effective process has a positive relationship with operational service quality.
H_0	Effective process does not have a positive relationship with operational service quality.
Results show that process does not have a strong association with operational service quality (see Table 4.10). Therefore, H_{3b}*= not supported.*	

Table 4.15: Hypothesis 3c evaluation

Hypothesis 3c	
H_{3c}	Equipment maintenance has a positive relationship with operational service quality.
H_0	Equipment maintenance does not have a positive relationship with operational service quality.
Results show that equipment maintenance has a strong association with operational service quality (see Table 4.10). Therefore, H_{3c}*= supported.*	

Table 4.16: Hypothesis 4 evaluation

Hypothesis 4	
H_4	Operational service quality has a positive relationship with operational service efficiency.
H_0	Operational service quality does not have a positive relationship with operational service efficiency
Results show that operational service quality has a strong positive association with operational service efficiency (see Table 4.10). Therefore, H_4*= supported.*	

Further survey result also suggest that the main reason for adoption of quality initiatives is to get it "done right the first time" (Figure 4.6) differing from key reasons in other sectors.

For example, according to Yahya et al. (2001), the main reason for adoption of quality initiatives by Malaysian firms is conformance to specification. The study, which surveyed 405 companies in Malaysia comprising of manufacturing and processing (63.7%), electric and electronics (23.46%), commodities (11.36%) and services (1.48%) highlighted internal organizational improvement and external pressure as key reasons.

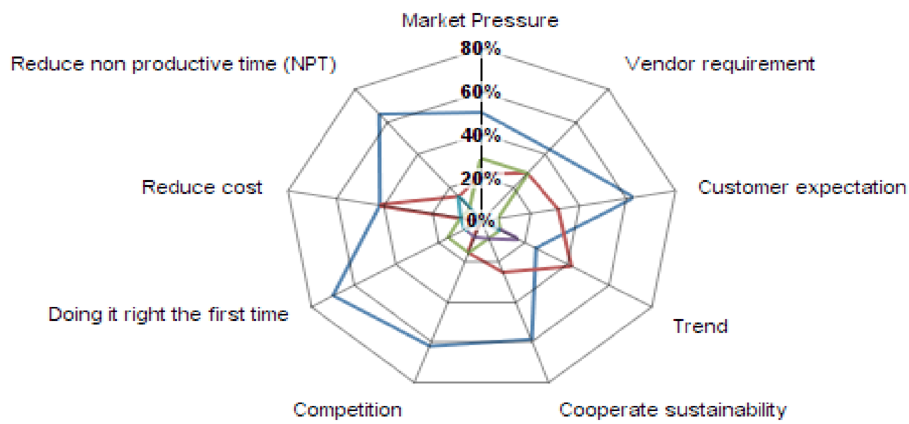


Figure 4.6: Reasons for adoption of quality initiatives

'Doing it right the first time' allows the organization to, not only satisfy the customer but also, position favourably in a competitive environment leading to increased market share, which inevitably translates to more profit. In other words, doing it right the first time is an all-encompassing quest enabling the achievement of customer satisfaction. This embodies Crosby (1987) philosophy that the way to manage quality is by prevention, not detection and testing. It is an attitude and commitment to prevention, stressing individual conformance to requirements. To Crosby, when people are asked to do it right the first time, 'requirements' are the "it" (Crosby, 1987). Prevention involves thinking, planning, and analyzing a plan, to anticipate where errors could occur, and then taking action to keep them from occurring.

Based on the questionnaire survey result analysis of this study, the framework was modified as shown in Figure 4.7. This revised framework when compared to the theoretical framework shown in Figure 2.8 narrows the empowerment antecedents down to the high level antecedents, which have been shown to have the strongest relevance to quality. It is believed that this framework could be of practical relevance in the industry, enabling targeted improvement in operational service quality faster.

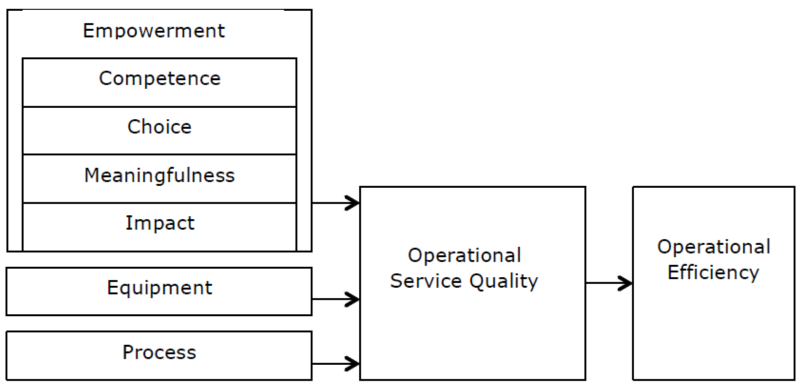


Figure 4.7: Revised framework

The empowerment components of competence, choice, meaningfulness and impact, represent the high level components whose interaction yields higher feeling of empowerment among the employees. Thus, by adopting the building blocks of the four high-level empowerment components identified as having very strong relationship with quality, it is believed that the psychological empowerment level will be improved and consequently drive operational service quality improvement together with effective maintenance and process.

Three case companies - OFSC-A, OFSC-B and OFSC-C (OFSC means oil field service company) were used to demonstrate practicability of the revised framework and result is as highlighted in section 4.4. Background profile of the three companies is shown in appendix F4.

4.4. Results and Analysis of Case Study Data

The result is presented following the seven steps outlined in section 3.5.4 and Figure 3.2.

4.4.1. Case Company OFSC-A

The quality outlook of OFSC-A is shown in Table 4.17 below

Table 4.17: OFSC-A Quality outlook

		Quality (Compliance with customer requirements and expectations)		
Categories		Service quality (Measure of ability to deliver quality service)		Product quality (Measure of ability to deliver quality product)
Four quality system focus	1	Quality management		
		Control	Correction	Improvement
	2	Competency		
		Competence training	Field and maintenance	Business system driven
	3	Operation optimization		
		Lean initiative	Field location	Business system initiative
	4	Strategic maintenance		
		Personnel		Process
Quality KPI category		Operational efficiency	Reliability KPI	Segment specific KPI
KPI Measure		Non-productive Time (hours)	Non-conformance rate (hours)	Segment specific
2014 KPI objective		25% NPT reduction	20% improvement in personnel productivity, 10x reliability improvement	Segment specific
Strategy for KPI objective		- Competency - Operating efficiency - Strategic maintenance	-Improve product lifecycle management processes	
Quality initiatives		Excellence-in-execution, quality stop cards, Lean, Do-it-right		
Maintenance population		About 10,000 people world wide		
Maintenance population nationality		Over 100 different nationality		

Situation in OFSC-A:

Until recently, maintenance was not recognized as a discipline that offers a career path for advancement. The field maintenance population was not viewed as strategic to the organization’s operational and overall success. For the most part, top management and even HR department have not been largely responsible for their recruitment, and the maintenance organization‘s development and career paths have either been non-existent or where they exist, have been driven primarily by way of individual need and personal initiative rather than a consistent, managed approach. The identification of suitable candidates for maintenance roles within the organization has been complicated by the lack of a generic role description or recruitment profile. Furthermore, the company had set an objective of 25% reduction in NPT and a 20% increase in personnel productivity in recognition of their quality improvement need.

To commence the study, the benefit of the research and how data obtained will be used was discussed in two face-to-face meeting held between the researcher, 3 field service managers and the quality focal point from OFSC-A. Over the course of 3 days, details of the research (objectives, benefits, how result will be used, length and limit of demographic information required) were discussed and communicated to field employees. Interview with identified 11 experts were scheduled and conducted over three visits to Labuan starting May to June 2014. (See appendix F1.1 for profile of experts and schedule).

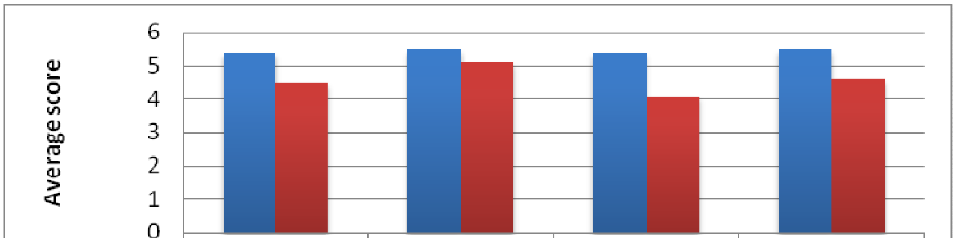
Table 4.18 presents summary of the challenges faced by OFSC-A.

Table 4.18: Summary of OFSC-A main challenges

Category	Challenges
Employee empowerment	•Increased personnel related non-productive time •Decrease in personnel productivity with respect to quality operations. •Lack of role /Job description for maintenance team. •No structured career path for maintenance team •Competency management for all staff irrespective of employment status. •Employee attitude and commitment
Equipment maintenance	•No track of real cost of maintenance due to inconsistent or incomplete maintenance update in maintenance system •Some equipment yet to be assigned part number and serial number limiting their entry into the database. •No documentation process for hardcopy maintenance documents thereby affecting equipment history
Process	•No coordinated operations support •No consistent management visit to location •Jungle of procedures

The initial empowerment level assessment questionnaire was manually administered to 90 out of 135 field employees over a two-day period to determine any empowerment gaps. Although some employees were out on field jobs, this was considered a good sample size for cross section survey. The survey yielded a response rate of 80%. Table 4.19 shows initial result of employee empowerment assessment survey conducted in May 2014.

Table 4.19: OFSC-A Initial empowerment level evaluation



	Decision making participation	Perception of immediate supervisor	Higher management involvement	Management of change
IAS	5.4	5.5	5.4	5.5
Initial EAS	4.5	5.1	4.1	4.6

Note: *IAS=Importance Average Score; *EAS=Effectiveness Average Score

Result showed a marginal participation in decision-making reflected in the 0.9 gap between the two scores of importance and effectiveness. Note that any gap score closer to 1 implies a yellow flag requiring attention or remedial action. Although all the respondents ranked management effectiveness as marginal, 11% (10) of the population representing 10-15 years seniority ranked management the least score of 4.5 compared to the score of 5.0 and 5.1 from the 17% (15) of '5-10 years' and the 72% (65) of 'less than 5 years' seniority respectively. Marginal levels of participation according to Narayan (2005), can confuse and lower trust level of employees, as they do not understand why they are included in decision making only some of the time. The lowest score was shown to be in the involvement or encouragement of participation in decision-making at the lowest possible level of employees, with a gap score of 1.3, which is greater than 1, signalling a yellow flag.

The perception of immediate supervisor, which demonstrates a focus on employee competence, ranked an average score of 5.5. Although management effectiveness in managing this factor is viewed as marginal, with an average score of 5.1, the gap between the two scores of importance and effectiveness is 0.3

(far less than 1), implying requirement for attention. However, question 7 (My supervisor values my suggestions and requests) and question 12 (My supervisor is concerned about my professional development) both scored an individual average lower than the rest of the questions in the group (3.5 and 4 respectively), suggesting areas for improvement. According to Narayan (2005), supervisors who are somewhat effective in meeting employees' needs for control realize the benefits of increased performance. However, they cannot expect full development of employee potential. The relationship of the employee with the supervisor could also be tapped into, to sustain a buy in on quality as result showed that the personnel are loyal to their supervisors. Supervisors can therefore provide encouragement, information and support, getting the employees to feel a stake in their success and become focused more on organizational goals as compared to personal needs.

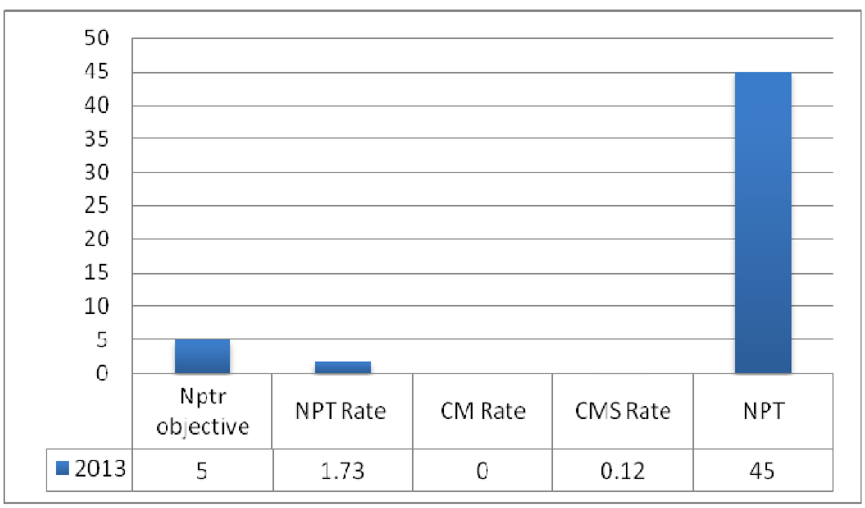
In perceptions of higher management which highlighted feelings of meaningfulness, the gap between the two scores of importance and effectiveness was found to be 1.3 which is greater than 1. This implied a needed focused attention before it deteriorates, and employees sceptical of organizational goals. Perception that management is inconsistently concerned about employees means trust levels go down, together with the sense of meaningfulness. Though loyal to supervisors and work groups, employees are not as committed to the organization. Closing or reducing this gap should be higher management priority and two areas to start, as demonstrated in the responses received, is in sharing of information with people at ALL levels and in being interested in training people at every level for advancement. According to Das et al. (2008), high-skilled and experienced employees would have greater contributory potential in the workplace than a disruptive one, so organizational dependency on such employees for performance outcomes would be greater.

The results also showed that the face of higher management is blurred to the employees. Out of the four parts in this evaluation, perception of higher management scored lowest in almost all of the six questions, when compared to the other three parts. This could lead to lack of commitment on the part of the employees. Perhaps it is a reflection of the separation in physical locations - higher management at KL and the personnel at the operational base in Labuan. Higher management should visit the operational base more frequently than they have done in the past since empowerment is all about capturing the hearts and minds of the personnel.

The gap between importance and effectiveness of management of change, which affects impact, showed a score of 0.98 suggesting a need for focused attention. Employees consider as very important their ideas and opinions being sought when change is contemplated but they view management as barely effective in this area. The implication of this result can be passive acceptance of the inevitable but with little enthusiasm or support. Employee involvement goes a long way toward reducing resistance to change and as the rate of change is high, it suggests personnel should be equipped to deal with change. The difference in importance and effectiveness of management raises a yellow flag with a score of 1.2. The 11% with 10-15 years experience feel that management is effective in change management, with a slightly above moderate score of 5.6. Nevertheless, the corresponding importance rank showed a not so critical importance with a score of 5.1. The 17% with less than or up to 5-10 years' experience view management as being moderately effective in management of change. Management of change must take into account the training, academic experience or competency level of the maintenance population. The changes introduced are usually viewed by the employees as too complicated, suggesting that the instructions will be by passed or short cut sought at the slightest opportunity and mostly not with the intent of causing a quality incident. Tendency is to fall back on what worked in the past, however non-compliant it may be. Standard work instruction is just a part of getting the job done; however the ultimate driver is the personnel.

An review of OFSC-A past operational quality performance result (KPI) for 2013 prior to start of this study (Table 4.20) showed a non-productive time rate (NPtr) of 1.73 against a 5.0 objective and an NPT total of 45 hours incurred in about 30,000 hours of operating time.

Table 4.20: OFSC-A Initial operational quality performance



Gaps identified from the interview and document review of 10 quality books and end of well reports, failure incident investigation reports and relevant databases are enumerated in Table 4.21. This was communicated in the feedback and action planning session, which is the fourth step in the process, over a

2-day period to the quality operations support manager, the quality focal point and the three field service managers.

Although the result obtained showed management effort needed on all four fronts of empowerment components, it was suggested that the organization focuses attention on the 3 factors with the lowest ranked measures namely decision making participation (4.5), higher management involvement (4.1) and management of change (4.6), together with other unique actions proposed by the managers in alignment with their 2014 set objective to improve the process and equipment gaps. The 2014 set objectives by OFSC-A include a more focused effort on getting it right the first time, every time; a push on human factors with particular attention to procedural adherence via standard work instructions; training reviews and update; competency management; establishment of an operations support organization; a commitment to following the zero tolerance rules; robust equipment maintenance; accurate reporting and a culture of checking it twice.

Table 4.21, 4.22 and 4.23 shows the summary of the identified gaps and recommendations for improvement. Re-evaluation was set for Dec’14 to allow time for implementation of recommended actions.

Table 4.21: OFSC-A Gaps identified from interview and document review

	Causes of NPT	Gaps	Problem caused
Employee psychological Empowerment	• Psychological disempowering situations - Lack of access to key database functionalities - Difference in management of direct and indirect hire - Low literacy level in maintenance team - Inadequate management appreciation of challenges faced by field personnel.	• Quality database administrator not in same operational location as users. • Basic work computers not distributed across board e.g. for indirect hire. • No recruitment structure and career development plans in place for indirect hire. • Inadequate management visibility	• Significant backlog of quality related entries and unresolved quality issues. • Decreased commitment or ownership due to decreased sense of belonging. • Sub standard job performance
Process	• Inconsistent adherence to quality book process • Inadequate closure of action items on quality • Inadequate dissemination of lessons learned • Redundant procedure	• Lack of commitment to process in place • Incomplete content of quality book • No dedicated personnel to ensure review and removal of redundant procedure	• Potential of repeat error • Delay in operation due to lack of relevant information • Jungle of procedures causing a barrier to its use
Equipment maintenance	• Incomplete equipment listing in maintenance database • Minimal use of maintenance database • Underutilization of database function e.g. work order functionality, which could help prioritize maintenance on equipment.	• Only one dedicated personnel making equipment listing entry • Lack of maintenance database training for the 1 dedicated personnel in charge.	• Backlog of equipment listing for entry (60% backlog) as at time of study leading to loss of equipment usage history. • Lack of confidence in use of maintenance database.

Table 4.22: OFSC-A Action for gaps and strategy implemented (I)

	Gaps	Recommended strategy and action	Reason	Outcome
Empowerment	• Quality database administrator not in same operational location as users. • Basic work computers not distributed across board e.g. for indirect hire. • No recruitment structure and career development plans in place for indirect hire • Inadequate management visibility	*Provide computers to all personnel without computers (quantity 10) or enough dedicated desktop computers (quantity 5 suggested). *Develop Job description for maintenance team. **Develop training Matrix *Link performance to skill area and competencies. *Employee team spirit enhancement via frequent rig location and operational base visit as part of managers objectives	• Employee make appraisal from their experience of job development and career advancement opportunities. • The visits provide platform for dissemination of information on strategic direction of company and management expectation. Sponsorship of learning and educational activities is vital for high level of quality (Marsick and Watkins, 2003, Nimon and Zigarmi, 2011).	Potential Improvement in perception and level of psychological empowerment

Note: For recommended strategy, **=Long term action *=immediate action

Table 4.23: OFSC-A Action for gaps and strategy implemented (II)

	Gaps	Recommended strategy and action	Reason	Outcome
Process	• Lack of commitment to process in place • Incomplete content of quality book • No dedicated personnel to ensure review and removal of redundant procedure	*Career profile creation by all employees in company database, highlighting resume info, career interest, aspirational roles, willingness to relocate etc. *Job supervisor to take ownership of quality book *Field service managers to remove redundant procedures	-Encourages individual employee participation in career advancement -Creates visibility to management -Eliminate Jungle of procedures causing a barrier to its use and procedural violations	Boost in sense of belonging or an owner awareness mindset, which is needed to foster commitment.
Equipment maintenance	• Only one dedicated personnel making equipment listing entry • Lack of maintenance database use training for the 1 dedicated personnel in charge.	*Empower maintenance team to enforce no work order = No maintenance (this is currently not in place) **Develop train-the-trainer courses	-A correct and up to date asset is a pre-requisite to equipment reliability (Narayan, 2011)	• Encourages listing to be updated. • Encourages mandatory use of database

Note: For recommended strategy, **=Long term action *=immediate action

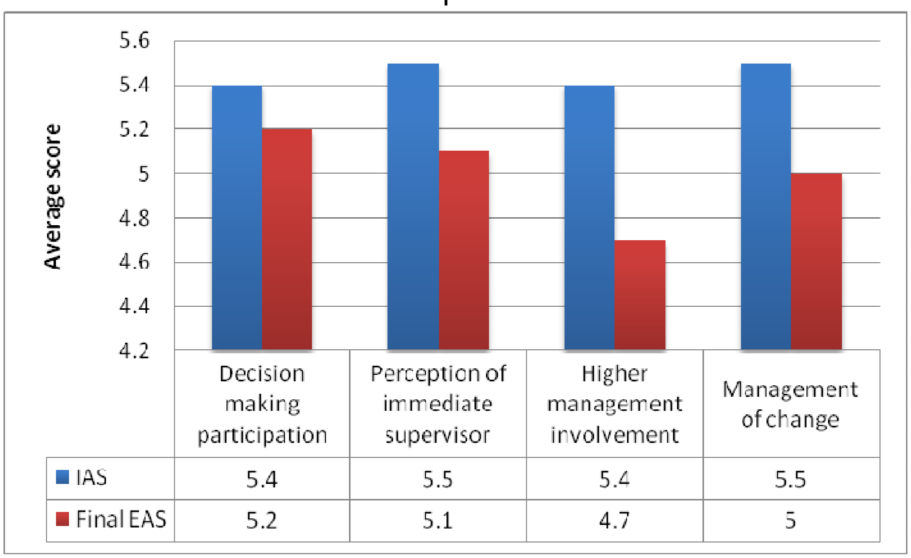
For personnel empowerment, OFSC-A management was able to provide 3 desktop computers for the maintenance population while providing access to all the personnel to enable use of any available computers. Ten (10) out of the 15-man maintenance team were given adequate access to enable individual update of career preferences while the remaining 5 personnel were to meet some stipulated company mandatory requirement.

The job supervisors enforced the completion of the quality book and to sustain the practice of its completion, initiated recognition of the readiness of the quality book prior to any field job as an achievement. This recognition, together with client satisfaction report, was to be rewarded at any of the company quarterly quality performance briefings. This recognition was done for 3 field personnel in respect of 5 field jobs performed over an 8-month period.

Furthermore, having only 1 person make the equipment listing entry into the database heightened the challenge for equipment maintenance in OFSC-A. However, although OFSC-A did not engage any more personnel to handle this, perhaps due to global downturn in activities of the industry at the time of this study, equipment being prepared for jobs was given priority listing in the database, bringing the database entry completion to about 80%. This completion status enabled the much-needed update and associated history documentation by the maintenance team prior to pre- job preparation and post-job execution. The 'no-work-order no work' policy means work could only be enforced for equipment already listed in the database. An exemption request which is approved only by the maintenance manager, had to be raised for those equipment that had not yet been loaded before any job call out. The exemption request was necessary since the equipment focal point did not have the necessary rights to generate codes for the equipment and code creation request takes no less than 10 working days posing a potential job readiness delay.

An empowerment re-assessment, together with evaluation of the end of year quality results was done was conducted Dec'14 - Jan 2015. This was done to ascertain the impact of the implemented measures on the field operation employees' psychological empowerment level, and consequently on operational quality. A total of 85 respondents were reassessed out of 100 employees. The number of employees had reduced from 135 to 100 due to a company initiated layoff exercise performed at the time of this exercise. The result of the re-evaluation is shown in Table 4.24.

Table 4.24: OFSC-A Final empowerment level evaluation



	Decision making participation	Perception of immediate supervisor	Higher management involvement	Management of change
IAS	5.4	5.5	5.4	5.5
Final EAS	5.2	5.1	4.7	5

Note: *IAS=Importance Average Score; *EAS=Effectiveness Average Score

Although management effectiveness is still seen as marginal, the result suggests an improved participation in decision-making by the employees. With an average score of 5.2, which is a 15% increase from the initial evaluation, results suggest employees now feel they are more involved in decisions affecting them. The effective management, according to Narayan (2005), would be in the rank range of between 5.5 and 7.0. Within this range, employees are more motivated and committed to a successful outcome, as they feel more involved in decisions affecting them. Furthermore, trust increases and employees develop to their maximum potential. A 0.2 gap between the two scores of importance and effectiveness indicate a significant improvement compared to initial survey. Furthermore, the difference in importance and effectiveness of involvement of lowest possible level of employees in decision-making improved with a score of 1.0 compared to 1.3 as at initial survey. Although this score is exactly 1, it still reflects the management move towards improvement in this area. Note that a difference of above 1 raises a yellow flag, while a difference of more than 1.5 reflect an even greater need for the organization to address the way the issue in question is handled. It reflects a potential for misunderstanding if not addressed (Narayan, 2005).

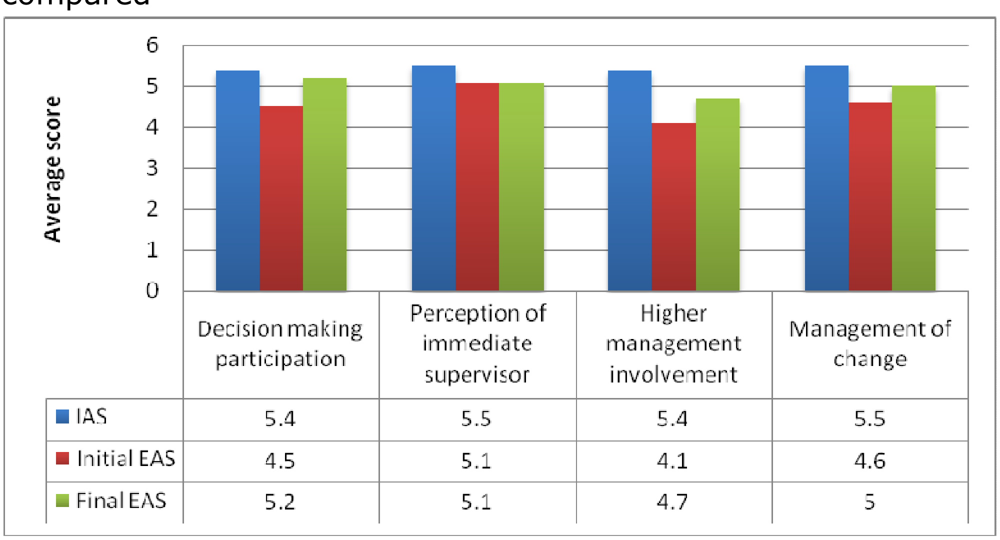
The management effectiveness in improving perception of immediate supervisor is viewed as marginal, with an average score of 5.1. However, the difference between the two scores of importance and effectiveness is 0.4, far less than 1, implying that there is a good attention on this aspect.

The gap of 0.7 between the two scores of importance and effectiveness in the effort to improve perception of higher management indicates an improvement from initial gap score of 1.3. Although there is perception that management is inconsistently concerned about employees, with the implication of reduced trust levels, employees are still loyal to supervisors and work groups. Perhaps, this lingering marginal perception is sustained by the re-organization exercise (downsizing and right sizing) undertaken recently by OFSC-A, leading employees response to suggest they are still unsure of their job security, hence a reduced sense of commitment to the organization.

In management of change, which reflects an effort in improving employee perception of impact, the gap of 0.5 between the two scores of importance and effectiveness is less than 1, suggesting a focused and improved attention. Perhaps this improvement is due to effort in review and removal of obsolete and redundant processes together with the series of conference calls organized between the process creators and the field users eliciting support from the employees. As in the initial survey, the rate of change continues to be high, demonstrated by the same score of 0.98. However, there has been frequent communication of expected changes and demo/pilot sessions to prompt feedback before implementation.

A comparison of the levels of employee empowerment before and after the implementation of the agreed remedial action plans, suggests that the initiatives engaged in by OFSC-A were successful in enhancing employee psychological empowerment as reflected in Table 4.25.

Table 4.25: OFSC-A Initial and final empowerment level compared



Another measure for assessing empowerment strategy effectiveness, according to Bettley et al. (2005), is to monitor changes in organizational structure as companies feel that decreasing management levels or flattening of its management structure, and increasing spans of control are important indexes of empowerment success (p. 264). The organizational structure of OFSC-A was evaluated, however, although there were a few reductions in management structure, this study could not confirm whether the re-organization exercise was necessitated by the industry wide down turn in activities, which culminated in downsizing and right sizing of many organizations or as a result of the implemented employee empowerment initiatives.

According to Mittal et al. (2015), nearly 50,000 energy jobs have been lost in the past three months on top of the 100,000 employees laid off since oil prices started to decrease in the fall of 2014. In addition to the major oil companies, many oilfield services companies have been aggressively pruning their workforce.

To professionalize maintenance roles, OFSC-A now recruits, promotes, and retains the right people as maintenance personnel and managers. A career framework has been put in place to attract new maintenance personnel from diverse disciplines. Furthermore, the structure recognizes excellence in the discipline, from both a theoretical and an operational perspective, and support growth and advancement. An apprenticeship model or ‘shadow’ maintenance role is under implementation to confirm the entry point into the maintenance career path while allowing a smooth exit for those who are better suited for other roles. Ultimately, this population is expected to know and be certified for all skills and tasks they are required to perform. Further upgrading of knowledge levels in line with more sophisticated tools are now taken to be a fundamental part in the future of the organization.

Maintenance leaders are henceforth seen as key location personnel, and are required to plan and prepare the future maintenance leaders for these additional expectations. Maintenance personnel at all levels are made responsible and accountable for maintaining equipment to pre-defined standards specified by the segment.

There is also a renewed focus on the reliability centred maintenance (RCM) process implemented in 2013. Traditionally, equipment had been maintained based on the assumption that failures become more likely as time goes on. For some assets, this is true; however, as the systems become more complex, the likelihood of random failures becomes higher. Based on a risk analysis of the asset, RCM defines maintenance tasks that need to be performed on a timely basis. This enables new assets to be put into effective service rapidly, working to deliver the highest asset availability and performance, including asset reliability and cost of service delivery. In most cases, RCM results in less required maintenance and improved asset utilization as a result, ensuring that all failure modes and patterns are covered.

Finally, the company has created a cross-segment maintenance community within the organization to enable and enhance communication across segments. This community allows anyone to easily communicate about maintenance databases, schedules, training, and proactive maintenance tasks. The goal of the maintenance community is to bridge the gaps between segment maintenance, share the learning's of experienced people that could propose new ideas, create a space for segment cross talk and innovation, and become the venue for sharing expertise. It is a platform of interaction created and encouraged among the practitioners. This makes it a participative community, where solutions are handy because ideas are shared.

Through these initiatives, the maintenance organization is not only keeping all of the assets and tools running well, but also helping to maintain the company reputation for quality service delivery. With the implementation of the proposed strategies, and the initiatives taken by the company, OFSC-A has been able to make significant progress as shown in the 2014 end of year operational quality result (Table 4.26).

The result showed a significantly high improvement in NPT reduction, demonstrated with a score much lower than that of 2013, bringing the reduction in total non-productive time by year-end 2014 to 33% versus the objective of 25% reduction.

Table 4.26: OFSC-A post implementation quality performance

	Nptr objective	NPT Rate	CM Rate	CMS Rate	NPT
2013	5	1.73	0	0.12	45
2014	1.3	0.32	0	0.13	15

7. Separation - A formal separation or closure (Van and Burke, 1995, McLean, 2005) of the 12 month long study was completed 31st April 2015 after a feedback meeting with the operations support manager. The researcher's contact is still maintained by OFSC-A should there be need for any further correspondence in the future.

4.4.2. Case company OFSC-B

Profile of the 7 experts interviewed is shown in appendix F2.

Situation in OFSC-B:

In performing the key operation of remedial work-over completion, the main challenge for OFSC-B was in achieving and sustaining an NPT lower than or equal to the company's quality objective of 10% of allowable period. Quality challenges and issues related to non-productive time raised during the interview process are tabulated in Table 4.27

Table 4.27: Summary of OFSC-B main challenges

Category	Challenges
Employee empowerment	•No structured technical training for employees •Understaffing – Few personnel performing most jobs •Employee attitude and commitment •Fear of punishment/blame culture
Equipment maintenance	•Maintenance team managing both facility and equipment hence no clear dedication •No computer based maintenance system, hence no visibility on equipment maintenance status •Equipment exposed to weather elements leading to frequent and unnecessary maintenance •No dedicated asset and (or) base manager located in the operation base. •Unavailability of spares when needed
Process	•No clear policy on equipment usage •Management of change policy not enforced •No consistent management visit to location •No dedicated physical store for inventory •No structured way of collecting customer satisfaction feedback.

Furthermore, the initial employee empowerment evaluation (Table 4.28) was performed to determine empowerment level of employees.

Table 4.28: OFSC-B Initial empowerment level evaluation

Empowerment factors	IAS (A)	EAS (B)	GAP (A-B)
Participation in decision-making	6.0	5.1	0.9
Perceptions of supervisor	5.8	4.4	1.4
Perceptions of higher management	5.5	4.0	1.5
Management of change	5.8	4.8	1.0

Note: IAS=Initial level and importance; EAS=Effectiveness of management

This initial empowerment result implies a low level in feelings of psychological empowerment of the employees. As shown in the result, there is a need for management focus and action on all four elements of the psychological empowerment evaluated, demonstrated by a ranking score value of greater than or closer to 1. Employee's significantly low perception of management commitment to enhancing empowerment often times feeds directly into the low level of empowerment feelings by the employee and the challenges experienced by the company. The high-level empowerment factor of competency is observed to be very important to the employee perhaps because, according to the interviewees, there is no structured technical training. This need could show up in employee's attitude and commitment, hence explaining the mention of this as a challenge by the interviewees. With a gap score of 1.4 and 1.5, demonstrating a low level of Feelings Competence and Meaning respectively, the employees may not find it worth their while to buy into the quality initiatives of the company. This observation and explanation is also extended to the scores for Choice and Impact explained by participation in decision-making and management of change respectively.

To ascertain the nature of non-productive time and trend experienced by the company, a review of 12 end-of-well reports for a project campaign of 12 oil field well operations, spanning 22 months (Jan 2014 – Oct 2015) was performed and result is as shown in Table 4.29 below. The operation time analysis (Table 4.29) highlights the key operations undertaken by OFSC-B in delivering their project scope, which include retrieval of mechanical barriers in old completion strings, retrieval of old completion tubing, sub-surface abandonment and surface abandonment. This operation is performed with a work over hydraulic unit otherwise called a snubbing unit. The main disadvantage of hydraulic work over unit is the trip time, although a lot of factors beyond the control of the operators could be attributed to this. An average of 20 to 30 (200 – 300 metres) joints can be tripped per hour.

A breakdown of the operations in the 12 oilfield well campaign is presented in Table 4.29 and Table 4.30. The percentage of the operating time of each operation is shown in Figure 4.8. It could be seen from Figure 4.8 that the trip time has the highest percentage of operating time at 32.7% of entire operating time

Table 4.31 shows the initial operational quality performance against planned time with a corresponding pictorial representation. From this table, it can be seen that the actual time spent on each of the operation is often times higher than the planned time. Out of the 12 oilfield wells worked on, only 5 were delivered well ahead of the planned time. A further review and analysis was performed to ascertain nature of the resultant non-productive time. This will enable effective resolution.

Table 4.29: OFSC-B Field operation time analysis

S/NO	Well1	Well2	Well3	Well4	Well5	Well6	Well7	Well8	Well9	Well10	Well11	Well12
1	**EXPECTED OPERATION BREAKDOWN TIME (DAYS)**											
	38	21	28	36	36	33	36	36	38	33	38	29
2	**ACTUAL BREAKDOWN OF OPERATION TIME LAPSE (DAYS)**											
	60	64	48	51	26	23	87	28	17	22	67	35
3	**BOP TEST TIME (DAYS)**											
	3	1	1	1	½	1	0.5	1	0.5	1	1	1
4	**AVERAGE RIG MOVE TIME (DAYS)**											
	8	5	5	5	4	4	4	5	2	2	5	4
5	**AVEARGE RIG UP TIME (DAYS)**											
	2	3	1	1	1	1	1	1	1	1	2	2
6	**AVERAGE RIG DOWN TIME (DAYS)**											
	1	3	1	1	1	0.75	1	1	1	1	1	1
7	**AVEARGE TRIPPING TIME (DAYS)**											
	22	28	12	16	6	9	7	8	2-1/2	5	42	15
8	**FISHING OPERATION REVIEW (DAYS)**											
	10	NIL	2	NIL	NIL	NIL	NIL	NIL	NIL	NIL	37	NIL
9	**SERVICE COMPANY/ THIRD PARTY OPERATION ANALYSIS (DAYS)**											
	5	7	5	4	4	5	4	5	5	2	4	5
10	**CASING RETRIEVAL (DAYS)**											
	8	10	4	4	4	3	4	3	4	4	3	3
11	**AVERAGE RIG UP TIME OF CASING JACK UNIT (DAYS)**											
	1	1	0.5	0.5	3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
12	**AVERAGE RIG DOWN TIME OF CASING JACK UNIT (DAYS)**											
	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
13	**SECTION MILLING OPERATION ANALYSIS (DAYS)**											
	NIL	1	10	7	NIL	NIL	4	NIL	NIL	NIL	NIL	NIL

Table 4.30: OFSC-B Field operation time analysis summary

Operation	Bop Test	Rig Move	Rig Up	Rig Down	Trip Time	Fishing Opt	3rd Party	Casing Retrieval	Rig Up Csg Jack	Rig Down Csg Jack	Section Milling
Total number of days	12.5	53	17	13.75	172.5	49	55	54	9.5	7	22
Percentage of total operating time %	2.5	10	3.2	2.6	32.7	9.3	10.4	10.2	1.8	1.3	4.2

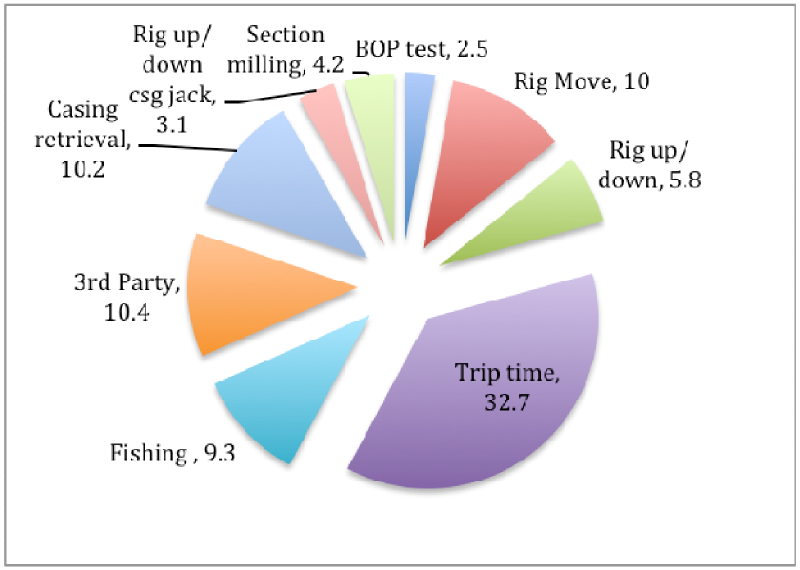


Figure 4.8: OFSC-B Percentage of total operating time

Table 4.31: OFSC-B Initial operational quality performance

	Well1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Well 9	Well 10	Well 11	Well 12
Planned time (days)	38	21	28	36	36	33	36	36	38	33	38	29
Actual time (days)	60	64	48	51	26	23	87	28	17	22	67	35
NPT (days)	8	21	7	2	2	0.7	50	5	2	2	11	3
Actual time less NPT (days)	52	43	41	49	24	22.3	37	23	15	20	56	32

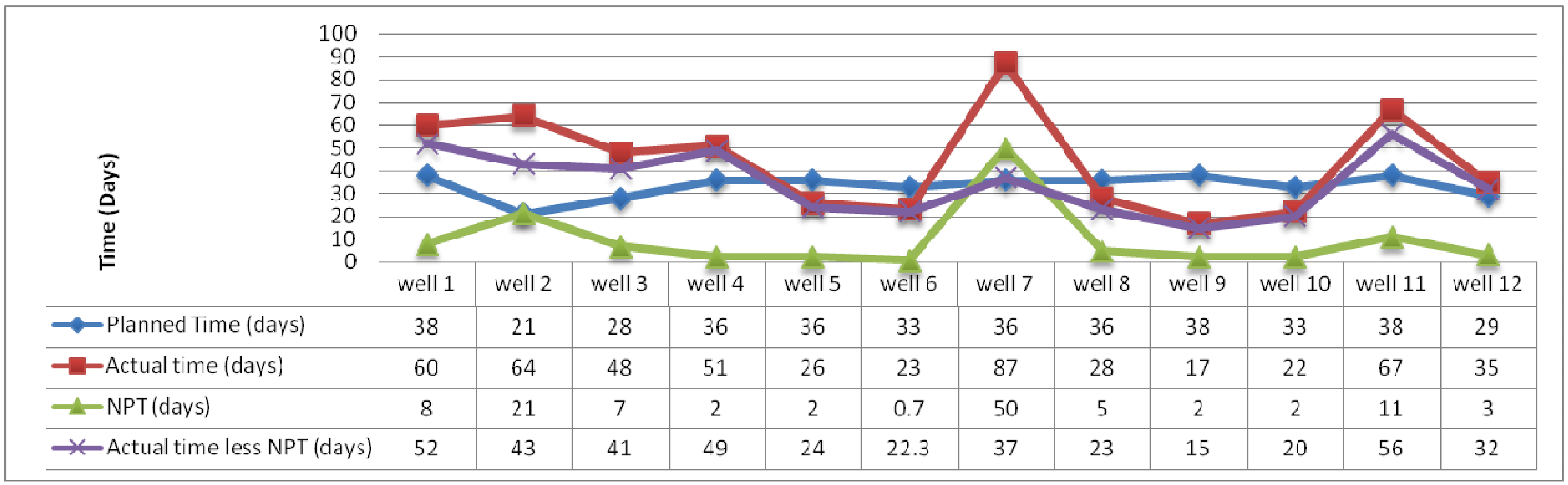


Table 4.32: OFSC-B Initial NPT Analysis

S/N	WELL NAME/NO	SURFACE EQUIPMENT	NATURE (WEATHER CONDITION)	LOGISTICS (CLIENT)	LOGISTICS (OFSC-B)	FISHING	OTHER SERVICE COMPANIES	HOST COMMUNITY SHUT DOWN	PERSONNEL INDUSTRIAL ACTION	WELFARE ISSUES (FEEDING/HOUSING)	PREMOB ISSUES	TOTAL NPT (HOURS)
		NPT DURATION (HOURS)										
1	Well 1	7	6	15.25	53	99	5	0	0	0	0	185.25
2	Well 2	312.5	0	15.5	0	0	0	8	0	0	90.5	498
3	Well 3	2.5	9	12.25	43.25	82	0	8.5	0	0	0	157.5
4	Well 4	17.7	0	19	0	0	0	2.3	0	3.75	0	42.75
5	Well 5	9	1.5	4	0	0	0	2	33.5	0	0	50
6	Well 6	5.5	1.5	6.5	0	0	2.5	0	0	0	0	16
7	Well 7	29.5	11.75	8.5	57.5	0	9.5	1056	0	0	19	1195.75
8	Well 8	0	2	14.25	0	0	0	78	0	0	0	121
9	Well 9	5	0	4.5	17.5	0	0	12	0	0	0	39
10	Well 10	1.5	4.5	16.5	0	0	2.5	0	0	17	0	42
11	Well 11	23	12	71.25	4.5	0	26.5	96.5	27	9.5	0	272.75
12	Well 12	5.5	0	3.15	10	0	1.5	40.5	0	0	0	60.65
Total NPT per class		523.45	48.25	190.65	185.75	181	47.5	1304	60.5	30.25	110	2680.65
Percentage NPT		19.5	1.8	7.1	6.9	6.75	1.8	48.64	2.26	1.13	4.1	

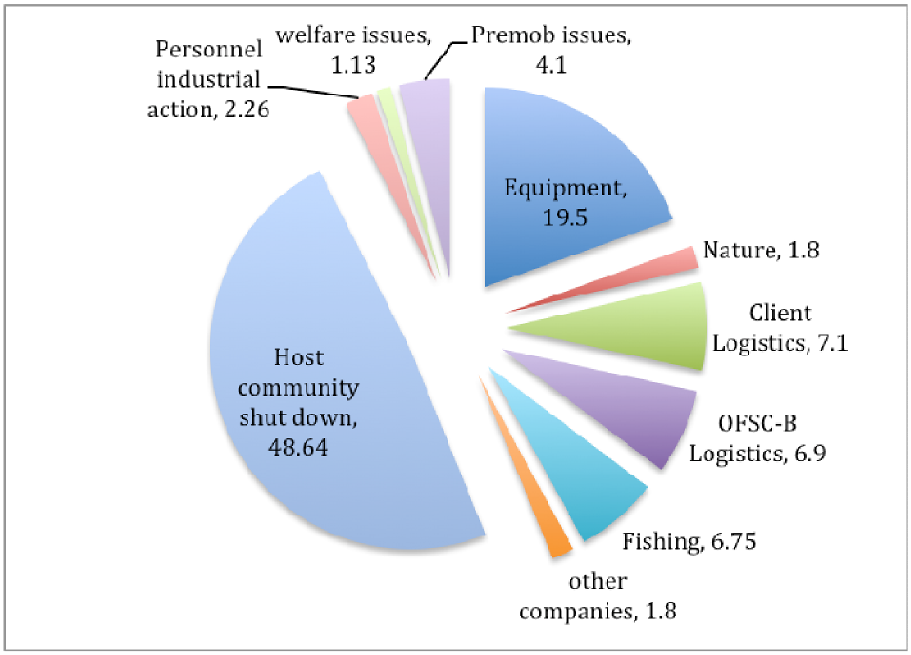


Figure 4.9: OFSC-B NPT classification by percentage

Table 4.32 and Figure 4.9 show the breakdown of the non-productive time from the 12 oilfield well operation. It could be seen that apart from the shut down of operation due to the host community interruptions (i.e. agitations/demonstrations by communities living around the oil fields), surface equipment contributed a total of 523.45 hours (21.8 days). This implies a 19.5% of total NPT and is significantly above OFSC-B quality objective of 10% or less of allowable period.

To further review the equipment related non-productive time, the performance of all equipment mobilized for the 12 wells were evaluated and result is shown in Table 4.33 and Figure 4.10. This evaluation was based on the failure count alone, and not on the details of the failure mode, nature or kind. The decision to use the failure count as basis for evaluation was due to challenge of locating detailed asset maintenance history.

Table 4.33: OFSC-B Equipment performance failure frequency

TOTAL NUMBER OF EQUIPMENT FAILURES														
S/N	**Well # /Equipment**	**Well 1**	**Well 2**	**Well 3**	**Well 4**	**Well 5**	**Well 6**	**Well 7**	**Well 8**	**Well 9**	**Well 10**	**Well 11**	**Well 12**	**TOTAL**
1	**Power pack 1**	0	0	0	0	0	0	0	0	0	0	2	2	4
2	**Power pack 2**	0	0	0	0	0	0	0	0	0	0	1	1	2
3	**Casing jack hydraulic power unit**	0	0	0	0	0	0	0	0	0	0	0	0	0
4	**Electric air compressor**	2	0	0	0	0	0	0	1	1	1	1	1	7
5	**Mechanical compressor**	0	0	0	0	0	0	0	2	0	2	2	2	8
6	**Accumulator Unit**	0	0	0	0	0	0	0	0	0	2	2	2	6
7	**Fire hydrant Pump**	0	0	0	0	0	0	0	0	0	0	0	0	0
8	**Choke/kill manifold**	0	0	0	0	0	0	0	0	0	0	0	0	0
9	**HWU Jack**	0	3	0	0	0	0	1	0	0	0	0	0	4
10	**5-1/2 Eckel power Tong**	2	1	0	0	0	0	0	0	0	0	0	0	3
11	**Annular BOP**	0	0	0	0	0	0	0	0	0	0	1	0	1
12	**Double ram BOP**	1	0	0	0	0	0	0	0	0	0	0	0	1
13	**Gin Pole**	0	0	0	0	0	0	0	0	0	1	2	2	5
14	**Mud Pump 1**	0	0	0	0	0	0	0	1	1	1	1	1	5
15	**Mud Pump 2**	0	0	0	0	0	0	0	0	0	0	0	0	0
16	**Centrifugal Pump**	1	0	2	0	0	0	0	0	0	0	0	0	3
17	**90BBLS Flowback Tank**	0	0	0	0	0	0	0	0	0	0	0	0	0
18	**430BBLS Storage tank**	1	0	1	0	0	0	0	0	0	0	0	0	2
19	**Traveler slip(hydra)**	1	0	0	0	0	0	0	0	0	0	0	0	1
20	**Stationary slip(cavin)**	1	2	1	0	0	0	0	0	0	0	0	0	4
21	**Open and Close test pump**	0	0	0	0	0	0	0	0	0	1	1	1	3
22	**80T Groove crane**	2	2	2	0	0	0	0	2	2	2	2	2	16
23	**Forklift**	0	0	0	0	0	0	0	2	2	2	4	4	14
24	45T Groove crane		2											2

Note: The number of failures does not represent duration of the equipment failures

The equipment failure count is shown below (Figure 4.10).

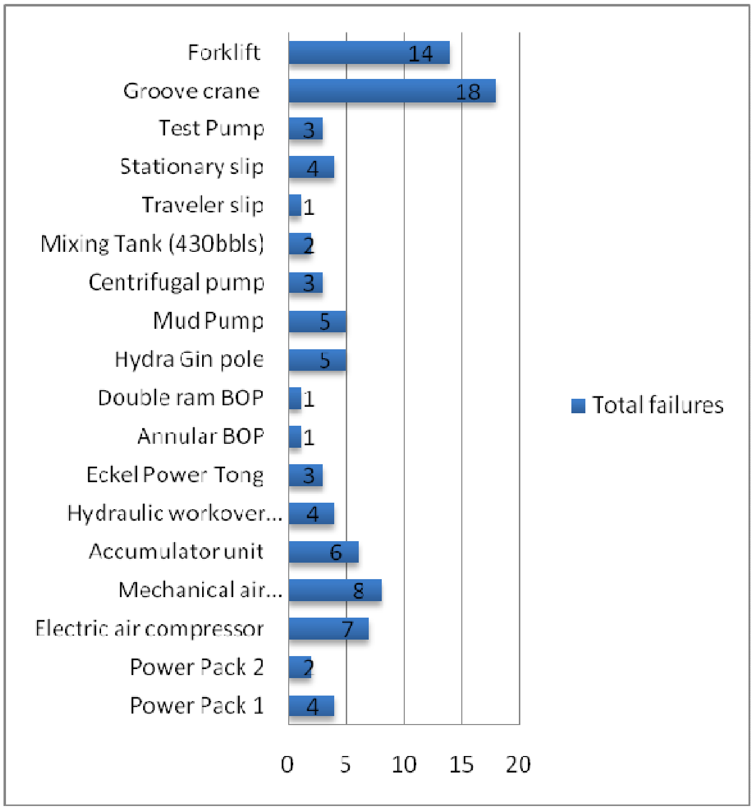


Figure 4.10: OFC-B Equipment failure analysis

Table 4.33 and Figure 4.10 showed the lifting equipment (Forklift and crane) as the greatest contributors to the equipment related failure count, followed by the mechanical and electrical compressors. To enable emphasis on the need for a focused attention on the elements of operational quality so far identified, an attempt at evaluating the financial implication of the incurred non-productive time for the 12 oilfield well campaign was made. The financial implication is highlighted below.

Financial Implication of NPT Incurred

1. Daily losses and increased running cost – The average daily cost of housing and feeding a typical crew of about 20 personnel in the hotel is about US$1478. For an NPT of 111.7

days (2680.25/24=111.7) therefore, the financial loss is about US$165,092.60, which the client will not pay due to lump sum nature of contract.

2. Loss of Man Hours- With an assumed average daily field bonus of about US$20 per personnel, the daily cost of personnel rig bonus amounts to US$400. Hence, for an NPT of 111.7 days, the total extra amount spent on personnel bonus equals US$44,680.00

3. Loss of revenue - From the review, a total number of 528 days was spent on the project with an NPT total of 111.7 days. Hence, the average number of days spent in each well equals 34.7 days less NPT days. Dividing the recorded NPT by the average day spent per well we will have a result of 3.2. This result implies extra 3 wells could have been completed within the period, demonstrating a potential revenue loss of about 3 times the lump sum contract rate per well.

The findings from the empowerment assessment, and review of end of job reports and other relevant materials were discussed with the quality operations manager, 2 field job superintendents and 3 job supervisors and 1 maintenance manager, in a feedback meeting. From the results, the focus in reducing non-productive time and improving operational service quality in OFSC-B was centred on the three elements of personnel empowerment, equipment and process. Recommended short and long-term actions are tabulated in Table 4.34, 4.35 and 4.36. Maintenance team carried out equipment maintenance. The immediate actions were implemented as soon as was practically possible, in preparation of upcoming phase of field operation involving 4 wells. Below is a summary of agreed action plan and goal.

Table 4.34: OFSC-B Action plan for implementation (empowerment)

Factor	Gaps	Action	Action plan goal/Reason
Personnel psychological empowerment	Poor understanding of how some of the equipment works.	* Initiate lunch and learn sessions for training demonstrations * Allocate mentees to senior engineers **Establish and enforce a structured training matrix for employees. **Train and recertify personnel on new equipment and technology application.	Enhance feelings of competence
	Communication gap between management and employees. No feedback on customer satisfaction of job performed.	* Develop a client satisfaction report or feedback form to be rated and signed by the client after every job. **Establish forum for frequent meetings with staff	Enhance the feelings of impact.
	Task purpose is not emphasized to foster sense of mission thereby affecting employee attitude and commitment.	* Effect regular management visit to field job site to demonstrate importance value of operation.	Enhance feelings of meaning
	Inadequate opportunity for young engineers to supervise jobs with minimal supervision.	**Create opportunities for developing skill set at work without fear of punishment for mistake.	Enhance feelings of choice

Note: **Long term action *immediate action

Table 4.35: OFSC-B Action plan for implementation (Process)

Factor	Gaps	Action	Action plan goal/Reason
Process	A total of 53 days were spent on rig movement operation representing 10% of actual time spent on entire operation	* Mobilize 10 pre-mobbed trucks for rig move instead of the usual 6. * Engage a second forklift during rig move instead of one. Use a 14-ton forklift for faster truck loading.	Reduce rig time movement
	A total of 30.75 days were spent on both rig up and rig down operations representing 5.8% of actual operation time	* Use of torque wrench for R/U and R/D of BOP's is faster and safer with potential 3hour saving for each operation.	Reducing rig up (R/U) and rig down (R/D) time
	Tripping time had the largest percentage of the actual operation time with 32.7% i.e. 172.5 days.	* Reduce stationary slip issue by using recommended slip pressures; avoid closing slips on tool joints and use of heat-treated pins on the slip to reduce the constant breaking. * Use of correct combination of dice on the Tong. * Ensure correct diameter measurements * Provide and use tongs with the right jaws as per the job specification.	Increasing Tripping Speed
	A total of 22 days was spent on section milling operation i.e. about 4.2% of the total time	**Use of wire line conveyed perforation instead of section milling for a potential time saving of about 4 days and stress reduction on unit and equipment.	Alternative to section milling operation option

Note: ** Long term actions *Immediate actions

Table 4.36: OFSC-B Action plan for implementation (Equipment)

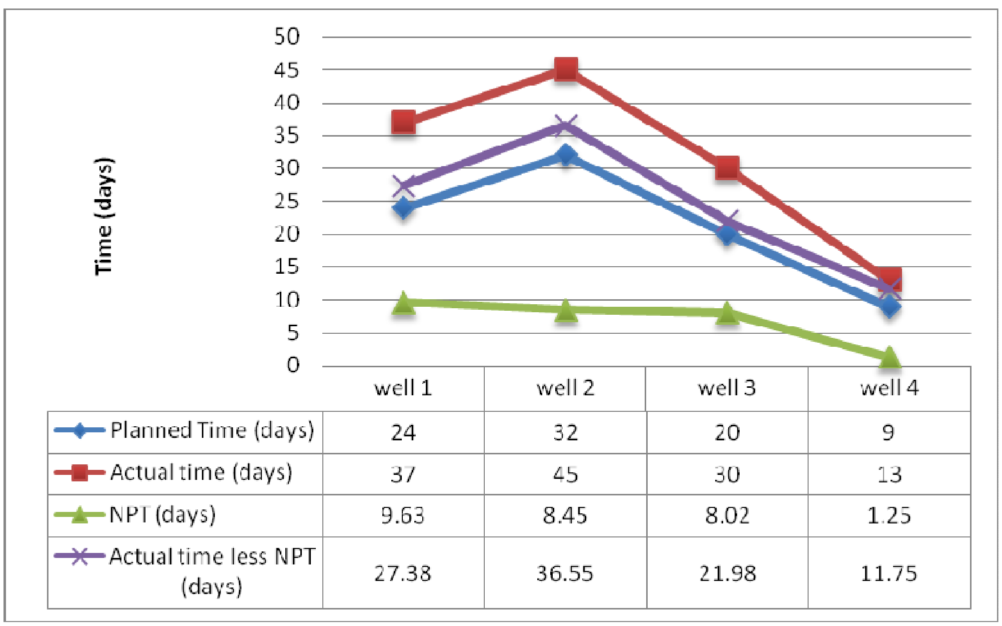
Factor	Gaps	Action	Action plan goal/Reason
Equipment maintenance	No readily available spares for failed equipment especially lifting equipment. No backup available for key equipment.	* Provide backup for main equipment and mobilize together with primary. * Develop quality book * Hold and document pre/post job meetings	Non interruption of operation
	Under gauged outside diameter of drill pipes	**Establish QAQC process. *Develop verification checklist for key equipment	Ensure signed/verifiable quality assurance of all equipment to be used
	Power generator capacity not suitable for operation	*Client job design team + OFSC-B to coordinate equipment selection.	Selection of the right equipment at the project planning stage
	Hydraulic system failure, Crane failure	**Training of 2 more personnel on use of hydraulic systems. **Develop structured cross training for critical equipment.	Ensure competent personnel on board on all job
	Excess runtime for generator without maintenance/servicing. No proper documentation of equipment failures for proper intervention and planning	**Establish an equipment status tagging system (red, orange/green). **Establish a computer based maintenance management system. * Educate team on strict compliance to manufacturer maintenance standard	Timely Preventive maintenance and ensure maintenance visibility
	Power pack engine failure due to substandard parts.	**Establish an inventory management team **Establish purchase department **Establish audited vendors *Establish dedicated quality team	Quality control and use of original parts and materials
	No physical inventory store for consumables parts/accessories. Equipment constantly under the weather	**Provide a 20ft container for spares **Build covered storage for equipment	All equipment stored under a shade/warehouse away from harsh weather

Note: ** Long term actions *Immediate actions

Results of the quality performance after the implementation of the action plans in the phase 2 of the project involving 4 wells are compared with the initial review, to check impact, and shown in Table 4.37 and the figure directly below it.

Table 4.37: OFSC-B Post implementation operational quality performance

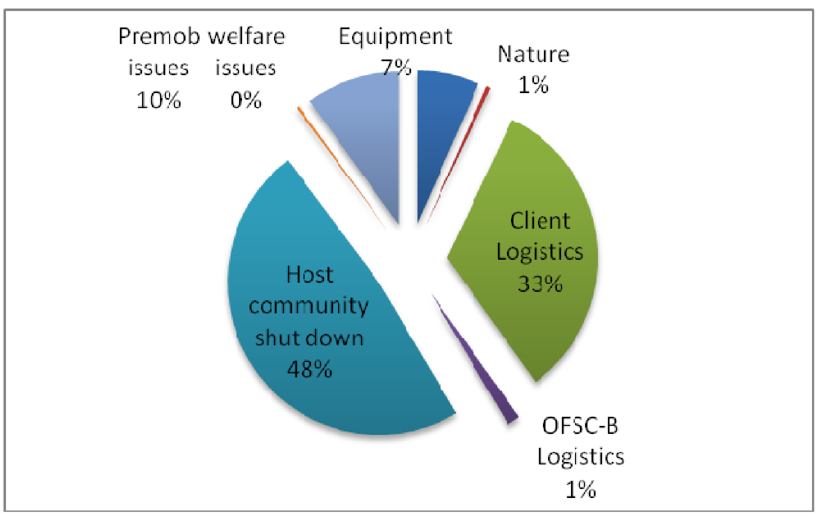
	Well 1	Well 2	Well 3	Well 4	Total
Man hours	33901	32089	24648	2028	92666
Planned time (days)	24	32	20	9	85
Actual time (days)	37	45	30	13	125
NPT (days)	9.63	8.45	8.02	1.25	27.35
Actual time less NPT (days)	27.38	36.55	21.98	11.75	97.66



Although the actual time spent on the field operation was still greater than the planned time with an average of 10 days, the average actual time spent on the job less NPT days is approximately 3.3 days. The total number of NPT days, although high in the first operation, showed a decreasing trend in the three subsequent well operations. A breakdown of the NPT analysis showed a decrease in the OFSC-B equipment related NPT (Table 4.38 and figure directly below).

Table 4.38: OFSC-B Post implementation NPT Analysis

Well name	EQUIPMENT	NATURE (WEATHER CONDITION)	LOGISTICS (CLIENT)	LOGISTICS (OFSC-B)	HOST COMMUNITY SHUT DOWN	WELFARE ISSUES (FEEDING/HOUSING)	PREMOB ISSUES /SECURITY	TOTAL NPT (HOURS)
Well 1	18	3	42	0	168	0	0	231
Well 2	14	0	102.75	5	77	2	2	202.75
Well 3	11.5	0	71.5	4	42	0	63.5	192.5
Well 4	0	0	0	0	30	0	0	30
Total	43.5	3	216.25	9	317	2	65.5	656.25
% NPT	6.63	0.46	32.95	1.37	48.30	0.30	9.98	



In comparing both initial and post implementation results, initial equipment NPT was 19.5% whereas post implementation result is 6.63%.

The equipment overall percentage NPT of 6.63% as shown in Table 4.38, as well as the individual well equipment NPT, meets the set OFSC-B quality performance NPT objective of less than or equal to 10% for the allowable period. Note that NPT related to nature, client logistics, host community, pre-mob/security are not attributed to OFSC-B.

The operation analysis (Table 4.39) showed a significant improvement. Rig up/rig down activity takes time due to regulations concerning safer access/escape and well control.

Table 4.39: Final operation time analysis

Operation	Bop test	Rig move	Rig up/ rig down	Trip Time	Fishing	Casing retrieval	Rig Up/down	Section Milling
Total number of days	1.6 8	4.13	4.77	30	11.03	11.17	1.83	0
Percentage of total operating time %	1.3	3.3	3.8	24	8.8	8.9	1.5	0

Furthermore, post employee empowerment evaluation also highlights an improvement in empowerment level (Table 4.40)

Table 4.40: OFSC-B Final empowerment level evaluation

Empowerment factors	IAS (A)	EAS (B)	FIAS (C)	FEAS (D)
Participation in decision-making	6.0	5.1	6.0	5.5
Perceptions of supervisor	5.8	4.4	6.2	5.4
Perceptions of higher management	5.5	4.0	5.8	5.0
Management of change	5.8	4.8	5.8	5.2

Note: FIAS=Final level and importance; FEAS=Final Effectiveness of management

The result of the final empowerment level assessment showed an improvement in OFSC-B management's effectiveness in managing the gaps. This improvement is also reflected in the feeling of empowerment by the employee and perhaps explains the improved operational quality performance as earlier shown in Table 4.37

These post implementation results were presented in a feedback session involving the operation manager and two job supervisors bringing the study to a close formally.

4.4.3. Case company OFSC-C

Situation in OFSC-C:

OFSC-C segment and operation investigated are the casing jack unit (CJU) operations. This is a more rugged unit for oil well casing cutting operation, allowing for burning of slips and seals, without having to rig down the unit. It incorporates pulling tool, that makes for easy retrieval of cut casing and with casing jack already rigged up, setting of bridge plug and cutting of casing is achieved faster. Typical bottleneck for casing Jack operation include rig move time, rig up time and connection time. Due to downturn in activities, OFSC-C is looking to improve its operational quality and perform more jobs for her only exploration and production company contract that is ongoing at time of this study.

The study in OFSC-C commenced with an initial face-to-face meeting with the field operations manager and the identification key personnel for interview. Profile of the 5 experts interviewed is shown in appendix F3.

The interview process yielded a familiar trend of challenges as seen with the other two cases studied. Key findings include, lack of structured training and low investment in employee career development, especially with the maintenance team. However, the interviewees implied that this situation might change in the near future as this is a relatively new company and low field activity level in the industry at the moment of study did not encourage much capital investment. Furthermore, being a relatively young company (8 years old), OFSC-C hires at the moment more mid career persons – those with some level of experience, than fresh university graduates perhaps explaining some of the employee empowerment challenge experienced. Table 4.41 presents a summary of OFSC-C main challenges.

Table 4.41: Summary of OFSC-C main challenges

Category	Challenges
Employee empowerment	• Lack of structured training for employees. • Lack of competency management and employee career development plans • No mentoring programme in place for new hires
Equipment maintenance	• Repeat and increased equipment failures • Lack of control over maintenance of some equipment outsourced to third party • No proper documentation of equipment failures or equipment failure closure • Inadequate use of Online database limiting visibility of maintenance activities • Sourcing of spares from reputable vendors
Process	• Increased rig move time during field operation • Increased rig up time during field operation

The initial psychological empowerment level evaluation of the field operation personnel was carried out with participation of 60 field personnel. Result is as shown below (Table 4.42)

Table 4.42: OFSC-C Initial empowerment level evaluation

Empowerment factors	IAS (A)	EAS (B)	GAP (A-B)
Participation in decision-making	6.2	5.9	0.3
Perceptions of supervisor	6.3	5.0	1.3
Perceptions of higher management	5.5	4.8	0.7
Management of change	6.1	5.4	0.7

Note: IAS=Initial importance; EAS=Effectiveness of management

Result from Table 4.42 shows a generally high level of empowerment feelings amongst the employees. A detailed analysis showed employee feel that they have considerable opportunity for independence and freedom in how they perform the job and are further allowed more latitude on the job as they gain expertise. This pattern is further expressed in their feelings of opportunity for impact and meaningfulness, which is reflected in perceptions of management of change and perceptions of higher management with gaps of 0.7 each. However, the area of concern is in effectiveness of management in enhancing feelings of competence, which is reflected in perceptions of supervisor, with a gap of 1.3. A gap with score higher than 1, signifies an area requiring focus and improvement.

A review of 5 casing jack project end-of-well reports, spanning over 18 months (Jan 2015 – June 2016) was carried out to find out trend of operational failure experienced by the company. The project equipment related failure breakdown is shown in Table 4.43.

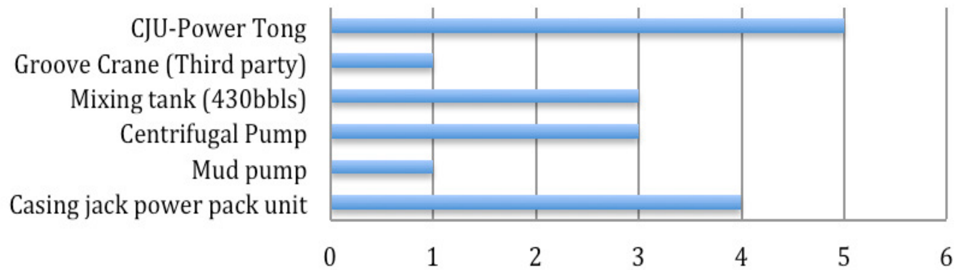
Table 4.43: OFSC-C Project Failure event break down

Project	Man-hours	Project failure event count	OFSC-C failure event count	Total project NPT (hours)	OFSC-C Equipment related NPT (hours)	OFSC-C percentage NPT
#1	*NRA	1	1	1	1	100
#2	2850	9	3	64.5	21	32.6
#3	930	7	6	10	2	20
#4	1705	2	1	16	10	62.5
#5	3020	6	6	60	60	100
Total		19	17	151.5	94	

Note: *NRA=Not readily available

Out of the 151.5 hours of non-productive time incurred in the entire 5 projects, 94 hours (62%) were attributed to OFSC-C equipment. To understand the details of the equipment related failures, an equipment performance analysis (Table 4.44) was performed on all the equipment mobilized for the project.

Table 4.44: OFSC-C Casing Jack Unit Equipment performance evaluation



	Casing jack power pack unit	Mud pump	Centrifugal Pump	Mixing tank (430bbls)	Groove Crane (Third party)	CJU-Power Tong
Total failures	4	1	3	3	1	5

The outcome of this review highlighted empowerment (competence), process (rig move and rig up time) and equipment maintenance as significant non-productive time drivers. This was discussed with the service delivery manager, the maintenance and field supervisors. The agreed action plan for implementation is shown in Table 4.45.

Table 4.45:OFSC-C Action plan for implementation

Factor	Gaps	Action	Action plan goal/ Reason
Employee psychological empowerment	Low feelings of competence amongst employees	**Develop relevant specific training courses for mid career persons that match current industry need. *Introduce knowledge sharing platforms e.g. lunch and learn, Mentor-mentee sessions	Enhance feelings of competence in employees. -Knowledge sharing and best practice dissemination.
Process	Complexity of rig-move due to low level of employee experience.	*Maintain the same experienced rig-move crew till end of project. *Use only client pre-mobbed equipment to avoid interruptions due to failures.	Enhance rig-move time
	Inadequate size of make/break tool increasing rig up time.	*Use adequate tubular diameter capacity make or break tool	Enhance rig up /connection time
Equipment maintenance	Repeated failure of key equipment. No readily available maintenance personnel on location. Improper job quality documentation (both for preparation, mobilization and post job)	*Perform maintenance on all failed equipment. *Enlist a maintenance team member as part of every job crew **Create online equipment maintenance database *Establish quality-focused dedicated team *Implement a quality book process for all jobs	-Ensure traceability of equipment status. -Ready repair of failures to reduce wait time. -Quality book will enable a structured job preparation, execution plan and post job demobilization.

Note: ** Long term actions *immediate action

In preparation for 2 new casing jack operation projects (Projects A and B) with planned duration of about 4 weeks, the immediate actions were implemented. The post implementation evaluation result of the two projects is shown below in Table 4.46.

Table 4.46: OFSC-C Post implementation NPT Analysis for Projects A and B

Project	Total project Man hours	Client equipmt related failure (hour)	OFSC-C equipment related failure (hour)	Weather / nature (hour)	Host dispute (hour)	Security (hour)	Other	Total NPT (hour
# A	29560	24.5	5	0	10.5	0	20	60
# B	21792	46	4	1.5	0	46	11.5	109
	Total	70.5	9	1.5	10.5	46	31.5	169

OFSC-C post implementation equipment related non-productive time for total project man-hours of 51,352 hours, as shown in Table 4.46, is 9 hours out of total project NPT of 169 hours. This suggests an improvement when compared to 94 hours of NPT out of 151.5 hours from the earlier 5 casing jack operations reviewed prior to implementing improvement actions.

The final empowerment evaluation (Table 4.47) showed that the employees feeling of competence still needed some boost with an effectiveness gap of 1.0. Perhaps, this is because mentor-mentee programmes require time to take off. According to Inzer and Crawford (2005), a well-run and successful mentoring programme takes time, dedication from both mentors and mentees and buy-in from the entire company.

Table 4.47: OFSC-C Final empowerment level evaluation

Empowerment factors	IAS (A)	EAS (B)	GAP (A-B)
Participation in decision-making	6.2	5.9	0.3
Perceptions of supervisor	6.3	5.0	1.0
Perceptions of higher management	5.5	4.8	0.7
Management of change	6.1	5.4	0.7

Note: IAS=Initial importance; EAS=Effectiveness of management

The result of the post improvement action implementation, which still showed a need for action on the element of competence, was communicated to the service delivery manager, the HR personnel and the maintenance supervisor in a feedback session. The feedback session enabled the researcher lay foundation for the intended effort in pursuance of improved quality. The study was brought to a close formally after the feedback session.

The modified or revised framework (Figure 4.7) generated based on the findings and results analysis of the field test questionnaire shown with model A (Figure 4.4) and model B (Figure 4.5), represents the key delivery for achieving objective RO3.

When compared to the theoretical framework shown in Figure 2.8, the significant improvement in the revised framework (Figure 4.7) is the narrowing and simplifying of the psychological empowerment antecedents down to only the high level antecedents that showed to have the strongest association to quality. It also placed empowerment at the topmost level of association to quality followed by equipment and then process. This implied that when the focus is on the empowerment factor, the company could leverage on the building blocks of the high level antecedents. This is then followed by a focus on equipment and process. It is believed that this framework could be of practical relevance in the industry, enabling targeted and faster improvement in operational service quality.

In a further validation of the framework in real live environment, three case study companies (OFSC-A, OFSC-B and OFSC-C) successfully adopted the revised framework to manage their non-productive time issue and personnel empowerment challenge. The overall operation results for each case company taken after the action plan and strategy implementation, and summarized in Tables 4.26, 4.38, and 4.46 respectively, provided evidence of its ability to deliver the intended outcome hence demonstrating the generic and practicality for use of the framework in the industry. In summary, For OFSC-A, NPT rate was reduced from 1.73 to 0.32 (Objective=1.3 NPT rate); OFSC-B result showed reduction in NPT from 19.5% to 6.63% (Objective= less than or equal to 10%); and for OFSC-C, there was significant NPT reduction (down to 5.3%) with increased man-hours of work.

Although the results were congruent with the revised framework, the usefulness and the effectiveness of the framework was elicited from the operation managers at the separation stage. The separation stage (i.e. the 7th stage of the case study steps) yielded opportunity for feedback on usefulness and effectiveness of the framework from the operations managers of the case study companies. Without user satisfaction, the approach would be less likely to be used and to produce beneficial results to the organization (Adesola and Baines, 2005). One of the comments received suggest that the framework is employee-focused and could be seen as taking control out of the hands of management thereby forestalling investment in terms of allocating resources. However, in an attempt to address this concern, the researcher asked the question:

Do you think the output of the framework is worth the time put in for its implementation?

Response from the 8 persons representing OFSC-A, OFSC-B and OFSC-C and comprising of 2 operations manager, 1 service delivery manager, 2 HR personnel, 2 job supervisors and 1 maintenance manager was unanimously in agreement that the result was worth the time put in for its implementation. Nevertheless, the OFSC-B quality operations manager remarked that companies would need to have a dedicated focus on continuous improvement for a seamless implementation. In terms of whether the framework will help the industry better perform a targeted quality improvement; the respondents commented that the framework enabled the intended result by helping them prioritize action plans and ideas although time will be needed to achieve some of the long-term action plan.

Additional learning and suggestions identified through the application of the framework at case study level is shown in the table 4.48. This is categorized in terms of implementation periods of prior, during and post implementation.

Table 4.48: Learning and suggestion from application of framework

Areas	**Learning/suggestion**
Prior to implementation	• Dedicate personnel to review trend of failures in order to prioritize focus area and actions. • Present findings to management to ascertain areas of resource allocation (if any).
During implementation	• Assign timeline for milestones in order to reduce time wastage. • Monitor progress of milestone and share with relevant persons
Post implementation	• Generate report of work done and result achieved to make a case for resource allocation.

The respondents maintained they would continue using framework as a guide for improving their quality focus and possibly customize to suit their purpose as new hires are recruited.

Overall the field test evaluation and case study result supported the usability and usefulness of the framework as a guide to achieving intended result on improved operational quality.

4.5. Chapter Summary

This study sought to determine the impact of the three critical success factor in operational service quality of the oilfield service industry. It brought together and interpreted both the qualitative and the quantitative data collected in this mixed methods approach. It was observed that whereas the theoretical study of operational quality largely embraced the three factors as equally important, empirical findings underscore the criticality of employee empowerment and equipment maintenance as strongly significant. Three case studies were further investigated to enrich finding and validate framework.

The evaluation of the employee empowerment in OFSC-A highlights that to achieve even better quality results, the crucial factor is the behaviour of everyone involved. Employees have to feel that they are empowered and motivated to act, to stop themselves and others from taking unnecessary risks and breaking the rules. Processes, and systems are indispensable, but on their own, they are not enough. Also, the maintenance team is in a unique position to provide valuable feedback to help ensure the tools remain reliable and costs are minimized where possible, without jeopardizing service quality.

Results highlighted in this chapter suggest that the three critical success factors do impact operational quality but in varying capacities. Furthermore, a focus on high-level antecedents of employee psychological empowerment suggests that the intended result will be achieved.

The following chapter presents the conclusions and recommendations based on a review of the relevant literature, together with findings from analyzed data.

CHAPTER 5

CONCLUSION, CONTRIBUTION, IMPLICATION AND DIRECTION FOR FUTURE RESEARCH

5.0. Aim

This chapter aims at drawing conclusions from the results and data analysis performed in chapter 4. It summarizes the principal research findings against the research objectives and outlines the contributions of this research. The implications to industry and practice, limitations of the research and finally some thoughts on the directions for future research are enumerated.

5.1. Conclusion on Research Objectives

This study set out to examine the significance of employee empowerment, process and equipment maintenance on operational service quality in the oilfield service industry. To achieve this aim, three specific research objectives (RO) were developed.

RO1. To determine the significance of employee psychological empowerment, process and equipment on operational service quality in oilfield service industry

RO2. To determine the significant antecedents of employee psychological empowerment in oilfield service industry

RO3. To validate the theoretical framework for improving operational service quality in oilfield service industry

The research strategy adopted for this study was a mixed method approach involving qualitative and quantitative analysis. Data collection was performed using a semi-structured interview method, and a questionnaire survey. Seventeen (17) subject matter experts were interviewed in the pilot whereas a total of 151 respondents participated in the main questionnaire. Three case study companies were used for enriching findings.

RO1 findings – To determine the significance of employee psychological empowerment, process and equipment on operational service quality, a theoretical understanding was gained from literature review and followed by quantitative survey. The result of the empirical survey suggests that employee psychological empowerment and effective equipment maintenance are the strongest significant factors of operational service quality in the oilfield service industry. Perhaps this is because processes put in place are fairly standard across the industry. The result, therefore, implies that if management of the oil field service companies focus on empowering employees effectively, and ensuring that the right equipment is in the right maintained condition, there is an even higher chance of achieving sustained operational quality service and reduced non-productive time. Hence, given the theoretical support for empowerment having an influence on quality improvement initiatives, a plausible conclusion is that employee psychological empowerment is one of many drivers of quality improvement although other cause elements may exist. The result further showed that operational service quality association with operational efficiency is very significant, explaining about 61% of operational efficiency. This result provides evidence of the relationship and supports the literature that efficiency of service operation is impacted by quality.

RO2 findings – Empirical result suggests that antecedents of employee psychological empowerment of relevance and strong impact in the oilfield service industry include Meaningfulness, Competence, Impact and Choice. These presented very strong association with psychological empowerment, whereas Responsibility, Accountability and Mindfulness did not show very strong predictors of psychological empowerment. Results suggest that employees need to feel they are appreciated for their contributions, have the resources to do their jobs to the best of their abilities, and have clearly defined opportunities to develop and advance within the organization. They must be empowered beyond being asked to meet performance goals.

RO3 findings – The revised framework was successfully applied in a live setting using three case study companies. The framework generated from the result and findings of the field-test analysis aimed at providing a targeted focus on elements with strong association with quality improvement.

The usefulness and usability of the framework was demonstrated in its enabling of the intended result reflected in the quality performance result as shown in chapter 4. The revised framework placed significant emphasis on the human factor suggesting that quality improvement effectiveness derives from judicious empowerment, utilization and engagement of human resources (Siegall and Gardner, 2000).

With respect to equipment maintenance, all three companies demonstrated the criticality of equipment maintenance and its associated element such as up-to-date database. The post improvement action implementation analysis of equipment related NPT analysis showed a significant reduction in NPT.

Additional learning and suggestion from the application of the framework is highlighted in Table 4.48 will enable implementation at different application stage.

Overall, the framework received positive feedback in terms of focus and achievement of result.

5.2. Contribution to Knowledge

In addition to the contributions highlighted in section 1.4 of chapter 1, this study has further provided significant contributions to the operational quality management knowledge and employee empowerment literature, specifically within the oil field service industry in the two following areas.

Firstly, the study categorizes the antecedents of employee psychological empowerment into high and low level antecedents, with the high level antecedents providing support for Thomas and Velthouse (1990) key antecedents of psychological empowerment of meaning, competence, impact and choice. The high level antecedents were demonstrated as having the strongest association to employee empowerment.

Secondly, this study highlighted the linkage between the three identified success factors for operational quality in the oilfield service industry. It shows that to improve and sustain operational service quality, the level of employee psychological empowerment has to be increased as well as ensuring that equipment is well maintained. According to Mellat-Parast (2013), the level and nature of employee involvement in the petroleum industry is limited and less emphasized due to the standardization of processes and operations, lack of attention to operations management thinking, and the regulatory structure of the petroleum industry (p. 188).

5.3. Implication to Practice

This section outlines five important lessons drawn from the findings that can be applied in practice by the industry. First, this study has shown that with focus on employee empowerment and an effective maintenance programme, the operational quality will be significantly and positively impacted. Maintenance as demonstrated by the empirical result must be considered a strategic aspect of the business. This implies that all the members of the maintenance team be made to feel a big part of the strategic plan and truly empowered to contribute.

Second, although in reality, quality benefits are gained over a long period of time, this practical framework may enable the organizations achieve an even quicker result, as they have a focused tool tailored to the industry.

Third, there is an assumption that a dedicated maintenance team is equivalent to dedicated quality team. These two have different focus and effort should be made to keep them separate.

Fourth, this study found that the majority of the indirect hire – a category that most of the maintenance team belongs to; feel isolated in company empowerment initiatives. According to International Labour Organization (2012), many workers in the oil and gas industry are employed through specialized services companies, and accidents are more prevalent for contract workers than for regular company employees (p. viii). Hence management of the organizations should pay particular attention to these sets of employees, particularly when they are handling equipment used in revenue generation, and in an era of skill shortage in the industry.

Finally, these results further demonstrate that management has a very significant role to play in a sustained environment for employee empowerment and operational service quality. According to Deming (1986) ‘improvement continues as long as management leads the programme’ (p.324).

5.4. Challenges and Limitations

This study was not devoid of challenges and limitations as with many academic researches. The key challenges, however, that future researchers need to be aware of include:

1. The willingness of the subject matter experts to voluntarily participate in the study. Privacy and confidentiality of information obtained needed to be ensured to encourage participation. Thus, an ethical protocol was developed and strictly adhered to, which inevitably limits the use of some of the information collected and presents some constraints in report findings.

2. The geographical distance between researcher and respondents in OFSC-A affected practicalities of frequent face-to-face relationship building with some of the respondents.

3. The challenge of integrating mixed methods results may have resulted in bias or under representation. However, every attempt has been made to minimize these errors by applying tested analytical methods, validating the findings and rigorously analysing the results.

4. The limited access to detailed information on operational service quality results and challenges meant the use of publicly available information to supplement and corroborate evidence where all else fails.

5. Although the profile of all those re-evaluated in OFSC-A was consistent with the profile of the initial empowerment assessment, it was impossible to survey or re-evaluate the same respondents due to the recent re-organization in the company that saw some of the initial participants exit the company.

Despite the limitations of this research endeavour, the resultant framework has practical application in the oilfield service industry and provides opportunities for future research. The directions for future research are outlined in the following section.

5.5. Direction for future work

While this study has shown the importance of the employee psychological empowerment, equipment maintenance and process, in the improvement of operational service quality in the oilfield service industry environment, it is suggested that further research be conducted to incorporate the element of technology as part of key success factors, as mentioned by the subject matter experts. This will perhaps provide a comprehensive understanding of the criticality of the operational service quality success factors in the oil and gas industry.

5.6. Concluding Remarks

The oil industry is increasingly facing a lot of pressure to operate efficiently. The findings of this study underscore that effective employee psychological empowerment and equipment maintenance need to be integral components of operational service quality strategies in order to improve and sustain quality, and consequently improve efficiency.

The conclusions provide a practical framework for strengthening linkages between employee employment, maintenance and process in the quest for improved operational service quality and efficiency.

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APPENDICES

Appendix A: Ethical Consideration

Awareness of Ethical Behavior for Data Collection

- ☑ Data gathering activities involving schools and other organizations will be carried out only with the agreement of the head of school/organization, or an authorised representative, and after adequate notice has been given.
- ☑ The purpose and procedures of the project, and the potential benefits and costs of participating (e.g. the amount of their time involved), will be fully explained to prospective participants at the outset.
- ☑ My full identity will be revealed to potential participants.
- ☑ Prospective participants will be informed that data collected will be treated in the strictest confidence and will only be reported in anonymised form, but that I will be forced to consider disclosure of certain information where there are strong grounds for believing that not doing so will result in harm to research participants or others, or (the continuation of) illegal activity.
- ☑ All potential participants will be asked to give their explicit, normally written consent to participating in the research, and, where consent is given, separate copies of this will be retained by both researcher and participant. These consent forms should be submitted as an Appendix, along with this form.
- ☑ In addition to the consent of the individuals concerned, the signed consent of a parent, guardian or 'responsible other' will be required to sanction the participation of minors (i.e. persons under 16 years of age) or those whose 'intellectual capability or other vulnerable circumstance may limit the extent to which they can be expected to understand or agree voluntarily'.
- ☑ Undue pressure will not be placed on individuals or institutions to participate in project activities.
- ☑ The treatment of potential research participants will in no way be prejudiced if they choose not to participate in the project.
- ☑ I will provide participants with my contact details (and details of the module convenor) in order that they are able to make contact in relation to any aspect of the project, should they wish to do so.
- ☑ Participants will be made aware that they may freely withdraw from the project at any time without risk or prejudice.
- ☑ Research will be carried out with regard for mutually convenient times and negotiated in a way that seeks to minimise disruption to schedules and burdens on participants.
- ☑ At all times during the conduct of the research I will behave in an appropriate, professional manner and take steps to ensure that neither myself nor research participants are placed at risk.
- ☑ The dignity and interests of research participants will be respected at all times, and steps will be taken to ensure that no harm will result from participating in the research.
- ☑ The views of all participants in the research will be respected and special efforts will be made to be sensitive to differences relating to age, culture, disability, race, sex, religion and sexual orientation, amongst research participants, when planning, conducting and reporting on the research.
- ☑ Data generated by the research will be kept in a safe and secure location and will be used purely for the purposes of the project (including dissemination of findings). No-one other than markers and examiners will have access to any of the data collected.
- ☑ Research participants will have the right of access to any data kept on them.
- ☑ All necessary steps will be taken to protect the privacy and ensure the anonymity and non-traceability of participants – e.g. by the use of pseudonyms, for both individual and institutional participants.
- ☑ Where possible, participants will be provided with a summary of research findings and an opportunity for debriefing after taking part in the research.
- ☑ If working with children 16 and under for a prolonged period of time, I have received Advanced Criminal Records Bureau (CRB) disclosure.

Signed Ngozi Onyemeh   Date 14 - 06 -15

Appendix B: Interview questions for quality expert

Part 1

What is your nationality?
What is your current position in the organization?
How long have you worked for the organization?

Part 2

1) What are your key performance indicators for quality performance?
   - Barriers to implementing quality in their experience
   - Quality and their relationship with vendors, suppliers and customers
   - Quality alignment with overall organization strategy.
2) How do you measure these KPI's?
3) What is/are the quality improvement initiative adopted as a means of continuous operational improvement in your organization?

   Past method-
   Current method-
   Future initiative-
4) What year did your organization start (or will start) the quality improvement initiative selected in question above?

5) Which is your company's main reason for adopting a quality improvement methodology? Could you rank or prioritize them?

6) How satisfied are you with the performance of your current quality improvement initiative?

7) What are the measurable benefits gained from the quality initiatives?

8) Which tools/techniques does your company use when adopting quality improvement methodology?

9) Do you have a quality department or dedicated personnel managing and handling day-to-day quality operations?

10) If yes, does your company have a quality career path for employees? And what levels of progression do you have?
11) Does your company align quality as part of the Key Performance Indicator in the performance appraisal system?

12) Which approach does your company use in implementing quality? E.g. DMAIC etc.

13) Which challenges were encountered during the implementation of your quality improvement initiative?

Appendix C: Interview questions for HR expert

Draft HR Expert Employee Empowerment Interview Questions

1. Apart from recruiting the right personnel for the organization, how involved is the HR department with personnel psychological empowerment process/programme?

2. Is the function of personnel empowerment handled solely by the respective divisions or is it centrally managed?

3. What are the empowerment strategies undertaken by the organization?

4. How effective have the empowerment strategies been to your organization?

5. What are the challenges encountered with personnel empowerment?

6. How does the organization enable employee to play an active role in the decision-making processes and activities that affect them?

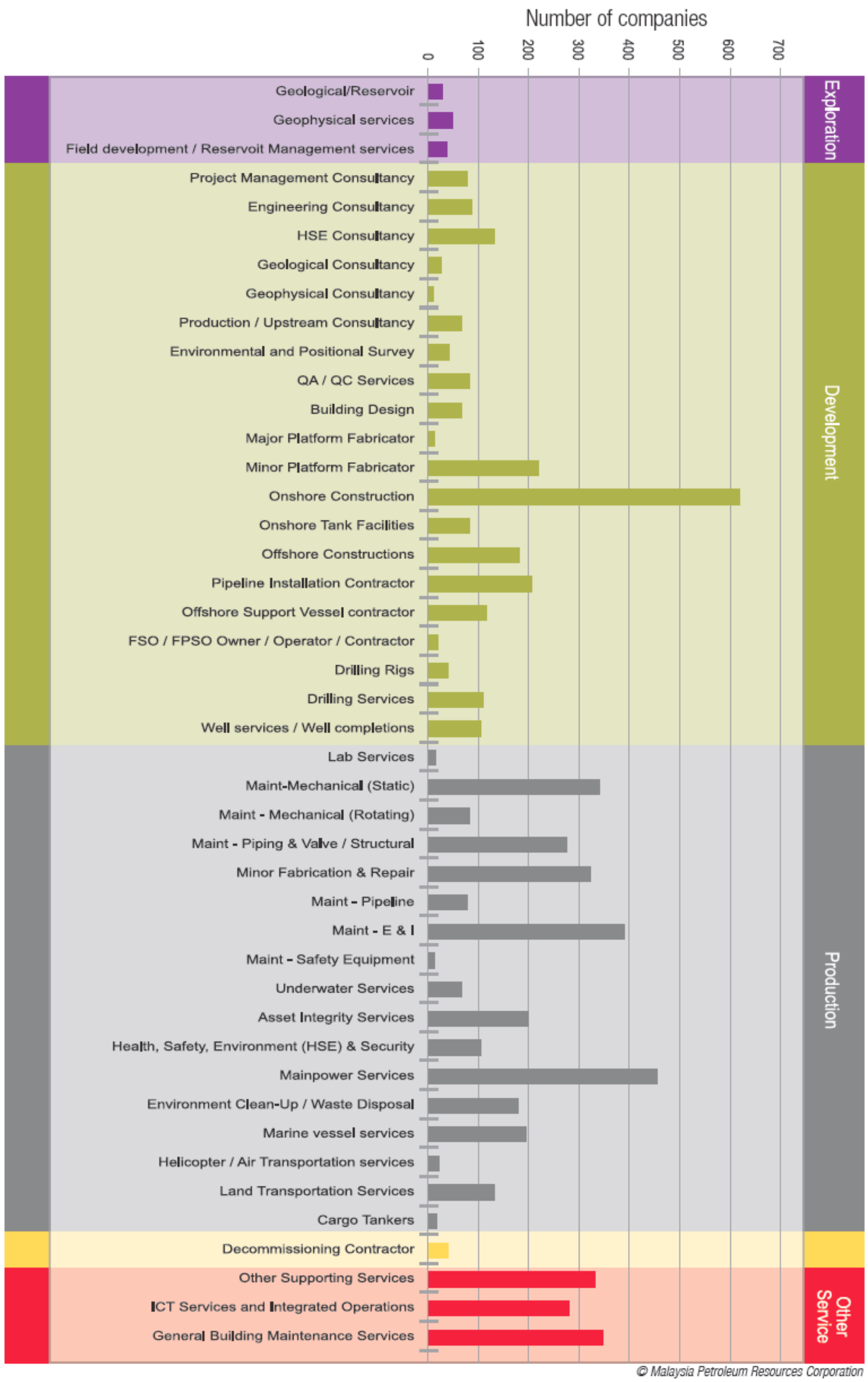
7. How does the organization provide accessible and timely information and opens up procedures, structures and processes for assessment?

8. How often does the organization monitor, and review progress and results against goals and objectives of personnel?

9. What is the process of feeding the learning from this back into the organization on an ongoing basis; and report on the results of the process?

10. What mechanism(s) does the organization use to address complaints against its decisions and actions, and ensures that these complaints are properly reviewed and acted upon.

Appendix D: Malaysia Oil and Gas Eco System



Appendix E: Data collection techniques used

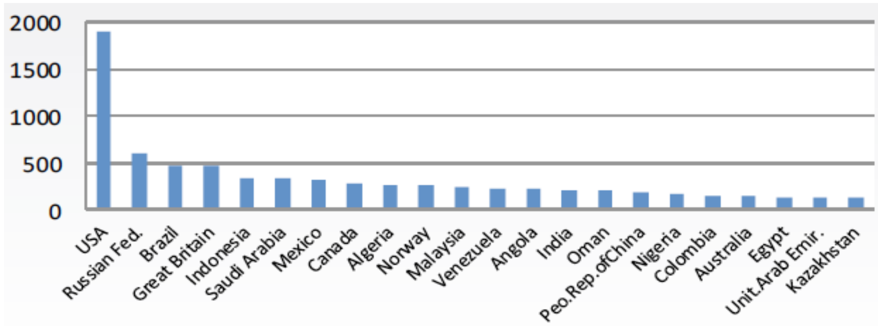
Data collection technique	# Conducted
Semi Structured Interview	17
Informal Interview	Yes
Questionnaire Survey	151
Case Study	1

Data Analyses technique	Conducted
-Conducting interviews and attending of meetings (quality and field operation meetings).	Yes
-Interview notes arrangements by theme	Yes
-Triangulation of information	Yes
-Correction or validation by interviewees	Yes
-Structural equation modelling	Yes

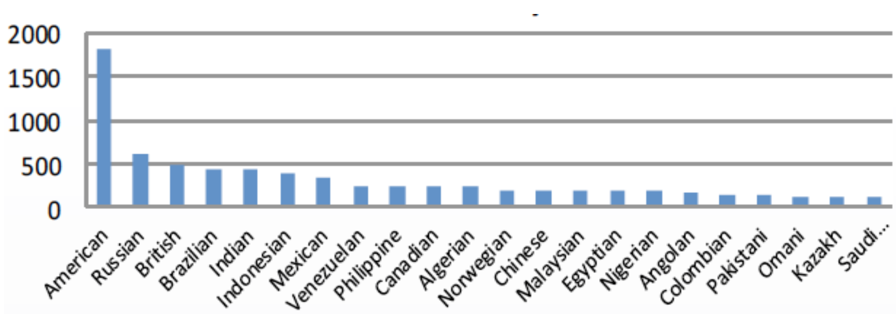
Appendix F1.1: OFSC-A interviewees profile

#	Respondent ID	Subject Matter Expert Position	Seniority (Years)	Interview Duration (Minutes)
1	R1	Field quality champion	>5	120
2	R2	Field service manager	>5	60
3	R3	Field service manager	>5	60
4	R4	Field job supervisor	>5	45
5	R5	Field job supervisor	>5	30
6	R6	Field job supervisor	>5	45
7	R7	HR Personnel	>5	55
8	R8	Workshop and maintenance Supervisors	>10	55
9	R9	Workshop and maintenance Supervisor (WMS)	>15	65
10	R10	Workshop and maintenance Supervisor (WMS)	>15yrs	55
11	R11	Quality operations support manager (QOSM)	>5yrs	60

Appendix F1.2: OFSC-A Maintenance Population



Appendix F1.3: OFSC-A Maintenance Team Nationality



Appendix F2: OFSC-B interviewees profile

No	Subject Matter Expert Position	Seniority (Years)	Interview duration (minutes)
1	Quality operations manager	>5	120
2	Maintenance manager	>5	60
3	Field superintendent	>5	60
4	Field job supervisor	>5	45
5	Field Engineer	>5	55
6	Quality focal	>6	55
7	HR personnel	>7	65

Appendix F3: OFSC-C Interviewees Profile

No	Subject Matter Expert Position	Seniority (Years)	Interview duration (Minutes)
1	Service delivery manager	>5	60
2	Field service manager	>5	45
3	Field job supervisor	>5	45
4	HR Personnel	>5	45
5	Maintenance Supervisor	>10	60

Appendix F4: Profile of Case Companies Studied

	OFSC-A	**OFSC-B**	**OFSC-C**
Services provided	Equipment rental and integrated well services, well completions	Hydraulic work over, tool rental, well completion and intervention services	Equipment rental and integrated well services, well completions
Field operation staff strength	135	90	60
Type/Country of operation	Multi-National/Malaysia	National/Nigeria	National/Nigeria
Company quality experience	30 years	12 years	8 years
Basic quality certification, ISO	ISO 9000	ISO 9000	ISO 9000
High profile clientele	Yes	Yes	Yes
Organizational structure	Hybrid (Matrix)	Hybrid (Matrix)	Hybrid (Matrix)
Interviewees avg. seniority	10+ years	6 years	6 years
Interviewees average age	40+ years	30+ years	30 - 40+ years
Number of interviewees	11	7	5

Appendix G: Employee Empowerment Evaluation Kit

(Adapted from Narayan 2005)

Part 1 –Employee empowerment evaluation survey introduction

The survey is designed to measure the extent to which the employees feel empowered to carry out their duties on behalf of the organization. Employees are asked to place appropriate number in the box to the right of the statement, then the researcher compute the survey averages. Participation is both voluntary and anonymous.

Part 2 - Employee Empowerment Evaluation Survey Instrument

Participation in Decision Making	Importance	Effectiveness
1) I am involved in making decisions that affect my work.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
2) I am given the opportunity to suggest improvements.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
3) I participate in setting the goals and objectives for my job.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
4) Proposed decisions are made at the lowest appropriate level.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
5) I have access to the information I need to make good decisions.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
6) As I gain expertise I am allowed more latitude on the job.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Perceptions of Immediate Supervisor	**Importance**	**Effectiveness**
7) My supervisor values my suggestions and requests.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
8) My supervisor encourages me to suggest ways to improve job quality.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
9) My supervisor encourages me to suggest ways to improve productivity.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
10) My supervisor encourages me to continually develop my job skills.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
11) My supervisor keeps me informed of job problems or concerns.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
12) My supervisor is concerned about my professional development.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Perceptions of Higher Management	**Importance**	**Effectiveness**
13) Higher management shares information with people at all levels.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
14) People at my level receive the resources needed to do the job right.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
15) Higher management values ideas and suggestions from my level.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
16) I have access to my supervisor's superiors when I need it.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
17) Higher management understands my job enough to evaluate my performance.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
18) Higher management is interested in training people at my level for advancement.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Management of Change	**Importance**	**Effectiveness**
19) Employees' ideas and opinions are sought when change is considered.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
20) I have a voice in the decision when changes are planned.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
21) The impact of technological change on people is always considered.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
22) Upcoming changes are talked about openly and freely.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
23) People are given adequate and appropriate training to deal with changes.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
24) The rate of change in this organization is right.	1 2 3 4 5 6 7	1 2 3 4 5 6 7

Part 3 -Employee Empowerment Evaluation Survey Profiles

1. Compute the average score from your employees for each group of eight (8) questions for each employee (space is provided for up to eight employees) – both in terms of importance and effectiveness.
2. Place the individual averages in the appropriate spaces
3. Compute the group averages.

See interpretative guide for general interpretation of the average scores.

Importance Scores - Averages

Employee	**Participation in decision making**	**Perceptions of immediate supervisor**	**Perception of higher management**	**Management of change**	**Individual overall average**
1					
2					
3					
4					
Group Average					

Effectiveness Scores - Averages

Employee	**Participation in decision making**	**Perception of immediate supervisor**	**Perception of higher management**	**Management of change**	**Individual overall average**
1					
2					
3					
4					
Group Average					

To interpret each profile, review the information provided in the grid below. Pay particular attention to those categories where the employee survey profile showed marginal and ineffective areas. Consider the gap between how important your employees consider a particular topic to be and how effectively the organization addresses that topic in their opinion. Differences of more than 1.5 reflect an urgent need to address the way your organization handles a particular issue. When comparing the employee survey to your own response, be aware that differences of more than 1.0 raise a yellow flag. Differences of more than 1.5 (in importance or effectiveness) reflect an even greater potential for misunderstanding, if not addressed.

Profile interpretation grid:

Category	INEFFECTIVE Effectiveness average between 1.0 and 3.5	MARGINAL Effectiveness average between 3.5 and 5.5	EFFECTIVE Effectiveness average between 5.5 and 7.0
Participation in Decision Making	Employees who are isolated from the decision making process feel "done to" rather than "done with." The consequence is low level motivation and commitment. These employees resist change and innovation.	Marginal levels of participation can confuse employees. They do not understand why they are included in decision making only some of the time. This often leads to lowering the trust level.	When employees feel involved in the decisions affecting them they are more motivated and committed to a successful outcome. Trust increases and employees develop to their maximum potential.
Perceptions of Immediate Supervisor	When a supervisor fails to provide encouragement, information and support employees feel no stake in their success and become focused on personal needs rather than organizational goals.	Supervisors who are somewhat effective in meeting employees' needs for control realize the benefits of increased performance. However, they cannot expect full development of employee potential.	When perceived as empowering, supervisors benefit from employee commitment and development. Employees are vested in meeting their own goals, those of the supervisor and of the organization.
Perceptions of Higher management	Management's perceived lack of concern is viewed as sufficient cause to do the minimum required for survival in the organization. Loyalty to the organization, its leaders, goals and objectives is low.	Perception that management is inconsistently concerned about employees means trust levels go down. Though loyal to supervisors and work groups, employees are not as committed to the organization.	Management sets the organization's standards. When standards include the recognition of each employee's potential contributions, individuals are motivated to rise to those high expectations.
Management of Change	Employees who are not involved in the implementation of change affecting their work are most likely to resist (and/or undermine) the effort. This increases costs and reduces the effectiveness of change.	Moderate employee involvement goes a long way toward reducing resistance to change. The result can be passive acceptance of the "inevitable" but with little enthusiasm or support.	Fully empowered employees seek positive, productive change as a way to increase their contribution to the goals and objectives of their immediate supervisor, higher management and the organization.

Appendix H: Pre-test questionnaire transcription

Key:

Respondent 1, 2, 4, 6 and 9= Quality operations Managers
Respondents 5, 7 and 8 = HR managers
Respondents 3, 10 and 11 = Completions operations supervisors

Interview question 1: Were the questions easy to understand?
Respondent 1: Majority was easy to understand.
Respondent 2: Very well.
Respondent 3: Yes.
Respondent 4: Yes, not technical at all.
Respondent 5: Very well.
Respondent 6: Yes.
Respondent 7: Majority of questions is quite layman.
Respondent 8: Very well.
Respondent 9: Yeah.
Respondent 10: Sure.
Respondent 11: Very well.

Interviewer question 2: Were there ambiguities in any of questions?
Respondent 1: Not really.
Respondent 2:Nope, I got the message so I think other people would
Respondent 3: Yes.
Respondent 4: No way.
Respondent 5: No.
Respondent 6: They were ok. No grey area for me.
Respondent 7: No.
Respondent 8: Not at all
Respondent 9: No.
Respondent 10: No ambiguities.
Respondent 11: I think it was an easy read.

Interview question 3: Were the questions worded correctly?

Respondent 1: Sure, non-technical guys can understand them.
Respondent 2: Very well.
Respondent 3: Yes.
Respondent 4: Simple grammar. Good.
Respondent 5: Very well.
Respondent 6: Good.
Respondent 7: My shop guys can understand them so I am fine with it.
Respondent 8: Very well.
Respondent 9: Yes.
Respondent 10: No big grammar. They are ok.
Respondent 11: I didn't have to use a dictionary. So they are ok (Laughs).

Interview question 4: Were you confused on how to rate your response?

Respondent 1: No. Measurements scale of 1 to 10 was ok. No issue with that.
Respondent 2: No
Respondent 3: No, not all
Respondent 4: No. It was evenly spread.
Respondent 5: No, the scaling was just right
Respondent 6: No
Respondent 7: No
Respondent 8: Not for me
Respondent 9: No, although some people may like to see "not applicable"
Respondent 10: No
Respondent 11: No

Interview question 5: Are the questions appropriate to measure constructs?

Respondent 1: I think so. Well again you mentioned that the variables are from literature so I think you can analyze with that.
Respondent 2: Seems ok to me
Respondent 3: Yes
Respondent 4: I think these constructs are not the very critical ones in the field. Here you need to have element of accountability and responsibility otherwise nothing gets done.
Respondent 5: Yes
Respondent 6: I think you should consider adding more questions, like "what could make the personnel feel more empowered?" This will help us reduce attrition.
Respondent 7: They are ok especially the ones on mindfulness; I think we need to look more into that in this industry.
Respondent 8: Yes
Respondent 9: Yes
Respondent 10: Yes
Respondent 11: Yes

Interview question 6: What are your general reactions to the questions?

Respondent 1: Too long. I like very short questionnaires but I guess you want to get more details.
Respondent 2: Within the context, however I suggest you give to people who will be honest in their response. Why do you say that? Ans. = I will be interested to know what my personnel say so don't use online to distribute this.

Respondent 3: Clear and straight to the point
Respondent 4: I like the fact that it is anonymous otherwise this is like washing dirty laundry in the open.
Respondent 5: Questions seemed appropriate
Respondent 6: Well done
Respondent 7: Ok
Respondent 8: OK
Respondent 9: OK
Respondent 10: OK
Respondent 11: OK

Interview question 7: How did you feel completing the question?

Respondent 1: ok
Respondent 2: Excellent
Respondent 3: It gave me things to think about really. I liked it.
Respondent 4: It's all right
Respondent 5: It is a very sensitive subject; I hope you don't disclose the name of the company that responded. Other than that I feel its good to address that. So I am ok with it.
Respondent 6: Ok
Respondent 7: Excellent
Respondent 8: Ok
Respondent 9: Overall, it was Ok
Respondent 10: No Hassle
Respondent 11: Ok

Interview question 8: Any additional comments

Respondent 1: None
Respondent 2: Don't ask the name of the company from personnel otherwise you wont get honest feedback. Make it completely anonymous.
Respondent 3: How do you deal with contract staff with this questionnaire, as a few are not our company direct staff?
Respondent 4: You may have to address the people first before giving them the questionnaire, as people here don't really know the importance of such survey.
Respondent 5: Reword question mindfulness to suit the industry.
Respondent 6: None
Respondent 7: I wish you all the best
Respondent 8: Can we have a look at the analysis when you are done? I think it's an interesting subject.
Respondent 9: Good luck Madam. I hope you come back to the industry when this is over. I will be willing to hire you honestly.
Respondent 10: No
Respondent 11: No. Let me know if you need any more info. Cheers

Appendix I: Field test survey instrument interview

No	Description of factors (Op. Quality)	1	2	3	4	5	6	7	8	9	10
A1	Extent to which rework levels have been reduced by operational quality management										
A2	Extent to which productivity of your company has been increased by operational quality management										
A3	Extent to which your company's non productive time has been reduced by operational quality management										
A4	Extent to which cost of operation have been reduced by operational quality management.										
A5	Extent to which customer complaints have been reduced by operational quality management										
A6	Extent to which profits of your company/division have been increased by operational quality management										

No	Description of factors (Meaningfulness)	1	2	3	4	5	6	7	8	9	10
B1	I understand how my work serves the organization's purpose										
B2	I understand how my work contributes to my life's meaning										
B3	I view my work as contributing to my personal growth										
B4	I know my work makes a positive difference in my Environment /community										
B5	The work I do serves a greater purpose										

No	Description of factors (Responsibility)	1	2	3	4	5	6	7	8	9	10
C1	I accept the level of task/role assigned to me										
C2	I can track and analyze my performance data										
C3	I have clear understanding of the standard of excellence expected from my task/role										
C4	I am able to multi task across disciplines										
C5	I feel responsible for the quality of work produced										
C6	I take pride in signing off against my work										

No	Description of factors (Accountability)	1	2	3	4	5	6	7	8	9	10
D1	I know my performance is monitored and measured against goals and objectives										
D2	I feel accountable for the result of my work										
D3	I am held accountable for the result of my work										
D4	I have control of the resources needed for my work										
D5 ***	I take ownership of my work from start to finish										

No	Description of factors (mindfulness)	1	2	3	4	5	6	7	8	9	10
E1	During an average day, people come into enough contact with each other to build a clear picture of the task/operation.										
E2	People are familiar with operations beyond one's own job.										
E3	There is a concern with building peoples competence and response repertoires										
E4	People around here take nothing for granted.										
E5	People are encouraged to express different points of view										
E6 ***	People report failures without fear of reprisal.										
E7	People in this organization value expertise and experience over hierarchical rank.										

No	Description of factors (Competence)	1	2	3	4	5	6	7	8	9	10
F1	I have enough confidence in my ability to do my job.										
F2	I am self-assured about my capabilities to perform my work activities										
F3	I have mastered the skills necessary for my job										
F4	I have the required training to do my job										
F5	I constantly update my competency level to do my Job										

No	Description of factors (Choice)	1	2	3	4	5	6	7	8	9	10
G1	I have the ability to choose how tasks are performed										
G2	I am free to select different approaches to my work										
G3	I have enough autonomy in determining how I do my job.										
G4	I have considerable opportunity for independence and freedom in how I do my job										
G5	I have permission to make judgment on how my tasks are performed										

No	Description of factors (impact)	1	2	3	4	5	6	7	8	9	10
H1	I feel I am contributing to the goals of my company										
H2	My impact on what happens in my department is large										
H3	I have significant influence over what happens in my organization										
H4	My work has a lot to do with the company's accomplishments										

No	Description of factors (process)	1	2	3	4	5	6	7	8	9	10
I1 ***	Process change/revision is promptly communicated to all personnel										
I2	Process change/revisions are properly documented										
I3 ***	There are too many processes its difficult to keep up with them										
I4	Our Processes are fool proof										
I5	Hold points are factored into the processes										
I6 ***	Some of our processes are too generic and not specific to my segment.										
I7	The design of our processes are undertaken by experts in the field										

No	Description of factors (Equipment)	1	2	3	4	5	6	7	8	9	10
J1 ***	Equipment availability due to maintenance has positively affected operational quality.										
J2	Equipment reliability due to maintenance has positively affected operational quality										
J3	Equipment maintenance is adequately carried out in my company										

J4	Equipment maintenance is strategic to operational quality in my company										
J5 ***	Equipment failures are properly tracked and addressed										
J6 ***	My company effectively trains equipment maintenance team										
J7	Equipment failures are properly tracked and addressed										

No	Description of factors (operational efficiency)	1	2	3	4	5	6	7	8	9	10
K1	Extent of non value added cost reduced by operational quality										
K2	Extent of non productive time reduced by operational quality										
K3	Extent of efficient resource utilization due to operational quality										
K4	Extent of cost of quality reduced by operational quality.										

No	Description of factors (How is quality measured)	1	2	3	4	5	6	7	8	9	10
L1	Acceptability- aesthetics, functionality, usability										
L2	Compliance- Ability to meet product specifications										
L3	Customer Satisfaction- Result of customer feedback										
L4	Defect count- Warranty, maintenance, recall, repair										
L5	Responsiveness- Ability to respond to requests quickly										
L6	Timeliness- Ability to deliver on time										
L7	Excellence in execution										
L8	Variation-difference between planned and actual										

No	Description of factors (Reason for quality)	1	2	3	4	5	6	7	8	9	10
M1	Market Pressure										
M2	Customer expectation										
M3	Trend										
M4	Cooperate sustainability										
M5	Competition										
M6	Doing it right the first time										
M7	Reduce Non productive time										
M8	Reduce Cost										

No	Description of factors (Empowerment)	1	2	3	4	5	6	7	8	9	10
N1 ***	Management interferes in the performance of my job										
N2	I am allowed to take work related decisions on my own without necessarily consulting my immediate supervisor										
N3 ***	I am allowed to use my own creativity in performing my assigned job										
N4	I have assess to information i need to perform my Job										
N5	I have sufficient authority to reject or accept the quality of work done										
N6	I am satisfied by the liberty granted me to perform my Job										

Note that items with asterisks *** are excluded in the final survey instrument due to poor factor loading.

Appendix J: Pilot test Result

Age bracket of respondents (years)	Race of respondents					
	Male	Female	Malaysian		Non-Malaysian	
20 –25	9	0	9		0	
26 –30	16	5	21		0	
31 –40	50	31	36		45	
Above 40	108	20	27		101	
Total	183	56	93		146	
Seniority	Male	Female	OFS employees		E&P employees	
			Male	Female	Male	Female
< 5yrs	54	9	39	5	15	4
5 –10 yrs.	45	18	24	4	21	14
10 –15 yrs.	43	14	37	14	6	0
15 –20 yrs.	14	15	0	0	14	15
> 20 yrs.	27	0	10	0	17	0
Total	183	56	110	23	73	33

Descriptive statistics of pilot test sample

```
      name:  <unnamed>
       log:  C:\Users\ksazvs\Dropbox\Acca\24May.smcl
  log type:  smcl
 opened on:  24 May 2014, 17:42:53

1 . reg empower accly mind resp imp choi comp meaning Gen_info i.Age  ORGTYPE i.St
```

Source	SS	df	MS		
Model	23.4669752	17	1.3804103	Number of obs =	239
Residual	19.4842697	221	.088164116	F(17, 221) =	15.66
				Prob > F =	0.0000
				R-squared =	0.5464
				Adj R-squared =	0.5115
Total	42.9512449	238	.180467415	Root MSE =	.29692

empower	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
accly	.4138835	.0685005	6.04	0.000	.2788858	.5488813
mind	.0643277	.0466102	1.38	0.169	-.0275297	.1561852
resp	.210972	.08752	2.41	0.017	.0384913	.3834527
imp	-.0813958	.0456458	-1.78	0.076	-.1713526	.008561
choi	.0952655	.0308055	3.09	0.002	.0345554	.1559756
comp	.0049863	.0535208	0.09	0.926	-.1004901	.1104626
meaning	.0509209	.0770994	0.66	0.510	-.1010231	.202865
Gen_info	.0292723	.0543511	0.54	0.591	-.0778404	.136385
Age						
3	-.147482	.1296926	-1.14	0.257	-.4030745	.1081106
4	.0366649	.1172393	0.31	0.755	-.1943853	.2677151
5	.0792949	.1215905	0.65	0.515	-.1603303	.3189201
ORGTYPE	-.0449307	.0587581	-0.76	0.445	-.1607285	.0708671
3.Staff	.4303847	.0605728	7.11	0.000	.3110104	.549759
EXP						
2	-.1636284	.0684721	-2.39	0.018	-.2985702	-.0286866
3	-.0990725	.0700714	-1.41	0.159	-.2371661	.0390212
4	-.120404	.1007227	-1.20	0.233	-.3189039	.078096
5	-.0092122	.1048127	-0.09	0.930	-.2157725	.1973481
_cons	.7040265	.3687688	1.91	0.058	-.0227269	1.43078

```
2 . reg empower accly resp imp choi i.Staff
```

Source	SS	df	MS
Model	21.0983694	5	4.21967388
Residual	21.8528755	233	.093789165
Total	42.9512449	238	.180467415

Number of obs =	239
F(5, 233) =	44.99
Prob > F =	0.0000
R-squared =	0.4912
Adj R-squared =	0.4803
Root MSE =	.30625

empower	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
accly	.434228	.0581003	7.47	0.000	.3197589	.5486972
resp	.2200134	.0622494	3.53	0.000	.0973697	.3426571
imp	-.0486153	.0358003	-1.36	0.176	-.119149	.0219184
choi	.1337708	.0261164	5.12	0.000	.0823162	.1852253
3.Staff	.4259354	.0536455	7.94	0.000	.3202433	.5316276
_cons	.6516564	.2524008	2.58	0.010	.1543769	1.148936

```
3 . reg empower mind comp meaning Gen_info i.Age  ORGTYPE
```

Source	SS	df	MS
Model	12.0714264	8	1.5089283
Residual	30.8798185	230	.13426008
Total	42.9512449	238	.180467415

Number of obs =	239
F(8, 230) =	11.24
Prob > F =	0.0000
R-squared =	0.2810
Adj R-squared =	0.2560
Root MSE =	.36642

empower	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
mind	.1357836	.0417273	3.25	0.001	.0535671	.2180002
comp	-.0361756	.0608467	-0.59	0.553	-.1560639	.0837126
meaning	.2633072	.0720057	3.66	0.000	.1214321	.4051824
Gen_info	.1020645	.0619161	1.65	0.101	-.0199308	.2240597
Age						
3	-.1755792	.1562518	-1.12	0.262	-.483447	.1322886
4	-.1496492	.1353469	-1.11	0.270	-.4163275	.1170291
5	-.0468114	.1378072	-0.34	0.734	-.3183373	.2247146
ORGTYPE	.1528663	.0521512	2.93	0.004	.0501111	.2556215
_cons	2.37164	.2756275	8.60	0.000	1.828562	2.914717

Appendix K: Field study Result

K1. Demographics

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	40	26.5	26.5	26.5
	Male	111	73.5	73.5	100.0
	Total	151	100.0	100.0	

Nationality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Other National	43	28.5	28.5	28.5
	Malaysian	108	71.5	71.5	100.0
	Total	151	100.0	100.0	

Age bracket

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 - 25 yrs	33	21.9	21.9	21.9
	26 - 30 yrs	35	23.2	23.2	45.0
	31 - 40 yrs	46	30.5	30.5	75.5
	Above 40 yrs	37	24.5	24.5	100.0
	Total	151	100.0	100.0	

Work Seniority

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	> 5 yrs	61	40.4	40.4	40.4
	5 - 10 yrs	37	24.5	24.5	64.9
	10 - 15 yrs	23	15.2	15.2	80.1
	15 - 20 yrs	18	11.9	11.9	92.1
	Above 20 yrs	12	7.9	7.9	100.0
	Total	151	100.0	100.0	

K2. Descriptive statistics (Factor analysis)

Measuring Operational quality

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Extent to which rework levels have been reduced by operational quality management.	6.86	1.296	151	0
Extent to which productivity of your company has been increased by operational quality management.	7.07	1.342	151	0
Extent to which your company's non-productive time has been reduced by operational quality management.	7.20	1.327	151	0
Extent to which cost of operation have been reduced by operational quality management.	6.93	1.360	151	0
Extent to which customer complaints have been reduced by operational quality management	7.34	1.285	151	0
Extent to which profits of your company or division have been increased by operational quality management	7.13	1.706	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.842
Bartlett's Test of Sphericity	Approx. Chi-Square	489.681
	Df	15
	Sig.	.000

Measuring meaningfulness

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Meaningfulness-I understand how my work serves the organization's purpose	8.43	.956	151	0
Meaningfulness-I understand how my work contributes to my life's meaning	8.28	1.190	151	0
Meaningfulness-I view my work as contributing to my personal growth	8.36	1.133	151	0
Meaningfulness-I know my work makes a positive difference in my environment/community	8.08	1.175	151	0
Meaningfulness-The work I do serves a greater purpose	8.31	1.109	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.744
Bartlett's Test of Sphericity	Approx. Chi-Square	159.657
	Df	10
	Sig.	.000

Measuring Responsibility

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Responsibility-I accept the level of task/role assigned to me	7.32	1.329	151	0
Responsibility-I can track and analyze my performance data	6.91	1.151	151	0
Responsibility-I have clear understanding of the standard of excellence expected from my task/role.	6.93	1.265	151	0
Responsibility-I am able to multitask across disciplines	7.09	1.213	151	0
Responsibility-I feel responsible for the quality of my work	7.14	1.172	151	0
Responsibility-I take pride in signing off against my work.	8.40	1.034	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.841
Bartlett's Test of Sphericity	Approx. Chi-Square	291.229
	Df	15
	Sig.	.000

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Accountability-I know my performance is monitored and measured against goals and objectives	7.95	1.079	151	0
Accountability-I feel accountable for the result of my work	6.91	1.151	151	0
Accountability-I am held accountable for the result of my work	6.93	1.265	151	0
Accountability-I have control of the resources needed for my work	7.14	1.172	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.711
Bartlett's Test of Sphericity	Approx. Chi-Square	142.792
	Df	6
	Sig.	.000

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Mindfulness-During an average day, people come into enough contact with each other to build a clear picture of the task/operation.	7.77	1.228	151	0
Mindfulness-People are familiar with operations beyond one's own job.	7.48	1.351	151	0
Mindfulness-There is a concern with building peoples competence and response repertoires	7.62	1.335	151	0
Mindfulness-People around here take nothing for granted.	7.43	1.393	151	0
Mindfulness-People are encouraged to express different points of view	7.81	1.230	151	0
Mindfulness-People in this organization value expertise and experience over hierarchical rank	7.91	1.139	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.779
Bartlett's Test of Sphericity	Approx. Chi-Square	221.797
	Df	15
	Sig.	.000

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Competence-I have enough confidence in my ability to do my Job	8.51	1.070	151	0
Competence-I am self-assured about my capabilities to perform my work activities.	8.42	1.067	151	0
Competence-I have mastered the skills necessary for my job.	7.85	1.086	151	0
Competence-I have the required training to do my job	8.04	1.177	151	0
Competence-I constantly update my competency level to do my Job	8.32	1.035	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.702
Bartlett's Test of Sphericity	Approx. Chi-Square	245.247
	Df	10
	Sig.	.000

Measuring Choice

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Choice -I have the ability to choose how tasks are performed	7.07	1.342	151	0
Choice -I am free to select different approaches to my work	7.20	1.327	151	0
Choice -I have enough autonomy in determining how i do my job	6.93	1.360	151	0
Choice -I have considerable opportunity for independence and freedom in how I do my job.	7.34	1.285	151	0
Choice -I have permission to make judgment on how my tasks are performed.	7.13	1.706	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.829
Bartlett's Test of Sphericity	Approx. Chi-Square	407.635
	Df	10
	Sig.	.000

Measuring Impact

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Impact-I feel I am contributing to the goals of my company	8.38	1.238	151	0
Impact-My impact on what happens in my department is large	7.97	1.368	151	0
Impact-I have significant influence over what happens in my organization	6.85	1.325	151	0
Impact-My work has a lot to do with my company's accomplishments	7.97	1.172	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.796
Bartlett's Test of Sphericity	Approx. Chi-Square	241.532
	Df	6
	Sig.	.000

Measuring process

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Process-Process change/revisions are properly documented	7.69	1.541	151	0
Process-Our Processes are fool proof	5.97	1.885	151	0
Process-Hold points are factored into the processes	6.87	1.439	151	0
Process-The design of our processes are undertaken by experts in the field	7.66	1.260	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.688
Bartlett's Test of Sphericity	Approx. Chi-Square	146.730
	Df	6
	Sig.	.000

Measuring Equipment

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Equipment-Equipment reliability due to maintenance has positively affected operational quality	6.74	1.074	151	0
Equipment-Equipment maintenance is adequately carried out in my company	8.32	.921	151	0
Equipment-Equipment maintenance is strategic to operational quality in my company	7.64	1.092	151	0
Equipment-Equipment failures are properly tracked and addressed	7.48	1.070	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.773
	Approx. Chi-Square	201.572
Bartlett's Test of Sphericity	df	6
	Sig.	.000

Measuring Operational service efficiency

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Operational Efficiency-Extent of non value added cost reduced by operational quality	7.26	1.319	151	0
Operational Efficiency-Extent of non productive time reduced by operational quality	7.42	1.344	151	0
Operational Efficiency-Extent of efficient resource utilization due to operational quality	7.35	1.323	151	0
Operational Efficiency-Extent of cost of quality reduced by operational quality.	7.25	1.297	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.778
Bartlett's Test of Sphericity	Approx. Chi-Square	560.145
	df	6
	Sig.	.000

Measuring Empowerment

Descriptive Statistics

	Mean	Std. Deviation[a]	Analysis N[a]	Missing N
Emp-I am allowed to take work related decisions on my own without necessarily consulting my immediate supervisor	8.11	1.255	151	0
Emp-I have assess to information i need to perform my Job	7.87	1.176	151	0
Emp-I have sufficient authority to reject or accept the quality of work done	8.21	1.129	151	0
Emp-I am satisfied by the liberty granted me to perform my Job	7.70	1.337	151	0

a. For each variable, missing values are replaced with the variable mean.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.795
Bartlett's Test of Sphericity	Approx. Chi-Square	289.418
	df	6
	Sig.	.000

K3. Reliability Analysis –Quality

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.885	6

Item Statistics

	Mean	Std. Deviation	N
Extent to which rework levels have been reduced by operational quality management.	6.86	1.296	151
Extent to which productivity of your company has been increased by operational quality management.	7.07	1.342	151
Extent to which your company's non productive time has been reduced by operational quality management.	7.20	1.327	151
Extent to which cost of operation have been reduced by operational quality management.	6.93	1.360	151
Extent to which customer complaints have been reduced by operational quality management	7.34	1.285	151
Extent to which profits of your company or division have been increased by operational quality management	7.13	1.706	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Extent to which rework levels have been reduced by operational quality management.	35.67	33.823	.593	.881
Extent to which productivity of your company has been increased by operational quality management.	35.46	30.823	.794	.850
Extent to which your company's non productive time has been reduced by operational quality management.	35.33	31.783	.729	.861
Extent to which cost of operation have been reduced by operational quality management.	35.60	31.749	.708	.864
Extent to which customer complaints have been reduced by operational quality management	35.19	31.916	.749	.858
Extent to which profits of your company or division have been increased by operational quality management	35.40	29.362	.659	.878

Reliability analysis for Meaningfulness

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.729	5

Item Statistics

	Mean	Std. Deviation	N
Meaningfulness-I understand how my work serves the organization's purpose	8.43	.956	151
Meaningfulness-I understand how my work contributes to my life's meaning	8.28	1.190	151
Meaningfulness-I view my work as contributing to my personal growth	8.36	1.133	151
Meaningfulness-I know my work makes a positive difference in my environment/community	8.08	1.175	151
Meaningfulness-The work I do serves a greater purpose	8.31	1.109	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Meaningfulness-I understand how my work serves the organization?s purpose	33.03	11.879	.326	.737
Meaningfulness-I understand how my work contributes to my life?s meaning	33.18	10.361	.413	.715
Meaningfulness-I view my work as contributing to my personal growth	33.10	9.517	.592	.641
Meaningfulness-I know my work makes a positive difference in my environment/community	33.38	9.503	.560	.654
Meaningfulness-The work I do serves a greater purpose	33.15	9.792	.565	.653

Reliability analysis – Responsibility

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. List wise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.804	6

Item Statistics

	Mean	Std. Deviation	N
Responsibility-I accept the level of task/role assigned to me	7.32	1.329	151
Responsibility-I can track and analyze my performance data	6.91	1.151	151
Responsibility-I have clear understanding of the standard of excellence expected from my task/role.	6.93	1.265	151
Responsibility-I am able to multitask across disciplines	7.09	1.213	151
Responsibility-I feel responsible for the quality of my work	7.14	1.172	151
Responsibility-I take pride in signing off against my work.	8.40	1.034	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Responsibility-I accept the level of task/role assigned to me	36.47	17.437	.618	.760
Responsibility-I can track and analyze my performance data	36.88	17.799	.714	.739
Responsibility-I have clear understanding of the standard of excellence expected from my task/role.	36.86	17.241	.687	.742
Responsibility-I am able to multitask across disciplines	36.70	18.320	.604	.763
Responsibility-I feel responsible for the quality of my work	36.65	19.149	.540	.778
Responsibility-I take pride in signing off against my work.	35.38	22.905	.211	.839

Reliability Analysis- Accountability

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.716	4

Item - Statistics

	Mean	Std. Deviation	N
Accountability-I know my performance is monitored and measured against goals and objectives	7.95	1.079	151
accountability-I feel accountable for the result of my work	6.91	1.151	151
Accountability-I am held accountable for the result of my work	6.93	1.265	151
Accountability-I have control of the resources needed for my work	7.14	1.172	151

Item - Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Accountability-I know my performance is monitored and measured against goals and objectives	20.97	9.026	.248	.785
Accountability-I feel accountable for the result of my work	22.02	6.766	.620	.582
Accountability-I am held accountable for the result of my work	22.00	6.373	.599	.591
Accountability-I have control of the resources needed for my work	21.79	6.901	.573	.611

Reliability Analysis- Mindfulness

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.770	6

Item Statistics

	Mean	Std. Deviation	N
Mindfulness-During an average day, people come into contact with each other to build a clear picture of the task/operation	7.77	1.288	151
Mindfulness-people are familiar with operations beyond ones job	7.48	1.351	151
Mindfulness-There is a concern with building peoples competence and response repertoires	7.62	1.335	151
Mindfulness-people around here take nothing for granted	7.43	1.393	151
Mindfulness-people are encouraged to express different point of view	7.81	1.230	151
Mindfulness-people in this organization value expertise and experience over hierarchical rank.	7.91	1.139	151

Item - Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach' Alpha if Item Deleted
Mindfulness-During an average day, people come into contact with each other to build a clear picture of the task/operation	38.25	19.976	.551	.727
Mindfulness-people are familiar with operations beyond ones job	38.55	20.063	.467	.749
Mindfulness-There is a concern with building peoples competence and response repertoires	38.40	20.869	.400	.766
Mindfulness-people around here take nothing for granted	38.60	18.096	.633	.702
mindfulness-people are encouraged to express different point of view	38.21	19.821	.566	.723
Mindfulness-people in this organization value expertise and experience over hierarchical rank.	38.12	21.172	.483	.744

Reliability Analysis- Competence

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.785	5

Item Statistics

	Mean	Std. Deviation	N
Competence-I have enough confidence in my ability to do my Job	8.51	1.070	151
Competence-I am self-assured about my capabilities to perform my work activities.	8.42	1.067	151
Competence-I have mastered the skills necessary for my job.	7.85	1.086	151
Competence-I have the required training to do my job	8.04	1.177	151
Competence-I constantly update my competency level to do my Job	8.32	1.035	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Competence-I have enough confidence in my ability to do my Job	32.63	10.182	.671	.708
Competence-I am self-assured about my capabilities to perform my work activities.	32.72	10.655	.591	.735
Competence-I have mastered the skills necessary for my job.	33.28	10.765	.556	.746
Competence-I have the required training to do my job	33.10	10.743	.490	.771
Competence-I constantly update my competency level to do my Job	32.82	11.294	.509	.761

Reliability Analysis- Choice

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.881	5

Item Statistics

	Mean	Std. Deviation	N
Choice -I have the ability to choose how tasks are performed	7.07	1.342	151
Choice -I am free to select different approaches to my work	7.20	1.327	151
Choice -I have enough autonomy in determining how i do my job	6.93	1.360	151
Choice -I have considerable opportunity for independence and freedom in how I do my job.	7.34	1.285	151
Choice -I have permission to make judgement on how my tasks are performed.	7.13	1.706	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Choice -I have the ability to choose how tasks are performed	28.60	22.376	.760	.846
Choice -I am free to select different approaches to my work	28.47	22.971	.715	.857
Choice -I have enough autonomy in determining how i do my job	28.74	22.663	.719	.855
Choice -I have considerable opportunity for independence and freedom in how I do my job.	28.33	22.903	.753	.849
Choice -I have permission to make judgement on how my tasks are performed.	28.54	20.530	.672	.875

Reliability Analysis- Impact

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.840	4

Item Statistics

	Mean	Std. Deviation	N
Impact-I feel I am contributing to the goals of my company	8.38	1.238	151
Impact-My impact on what happens in my department is large	7.97	1.368	151
Impact-I have significant influence over what happens in my organization	6.85	1.325	151
Impact-My work has a lot to do with my company's accomplishments	7.97	1.172	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Impact-I feel I am contributing to the goals of my company	22.79	10.675	.675	.797
Impact-My impact on what happens in my department is large	23.21	9.404	.761	.757
Impact-I have significant influence over what happens in my organization	24.32	10.661	.606	.828
Impact-My work has a lot to do with my company's accomplishments	23.20	11.120	.662	.804

Reliability Analysis- Empowerment

Case Processing Summary

		N	%
	Valid	151	100.0
Cases	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.857	4

Item Statistics

	Mean	Std. Deviation	N
Emp-I am allowed to take work related decisions on my own without necessarily consulting my immediate supervisor	8.11	1.255	151
Emp-I have assess to information i need to perform my Job	7.87	1.176	151
Emp-I have sufficient authority to reject or accept the quality of work done	8.21	1.129	151
Emp-I am satisfied by the liberty granted me to perform my Job	7.70	1.337	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
emp2	23.77	10.122	.644	.841
emp4	24.01	9.493	.823	.767
emp5	23.67	10.396	.710	.815
emp6	24.19	9.685	.645	.845

Reliability Analysis- Process

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.724	4

Item Statistics

	Mean	Std. Deviation	N
Process-The design of our processes are undertaken by experts in the field	7.66	1.260	151
Process-Our Processes are fool proof	5.97	1.885	151
Process-Hold points are factored into the processes	6.87	1.439	151
Process-Process change/revisions are properly documented	7.69	1.541	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Process-The design of our processes are undertaken by experts in the field	20.53	14.397	.521	.667
Process-Our Processes are fool proof	22.22	11.385	.474	.705
Process-Hold points are factored into the processes	21.31	11.922	.702	.554
Process-Process change/revisions are properly documented	20.50	13.812	.417	.717

Reliability Analysis- Equipment

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.811	4

Item Statistics

	Mean	Std. Deviation	N
eqp2	6.74	1.074	151
eqp3	8.32	.921	151
eqp4	7.64	1.092	151
eqp7	7.48	1.070	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
eqp2	23.44	6.261	.683	.737
eqp3	21.85	7.632	.512	.814
eqp4	22.54	6.130	.695	.730
eqp7	22.70	6.477	.635	.761

Reliability Analysis- Operational efficiency

Case Processing Summary

		N	%
Cases	Valid	151	100.0
	Excluded[a]	0	.0
	Total	151	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.933	4

Item Statistics

	Mean	Std. Deviation	N
Operational Efficiency-Extent of non value added cost reduced by operational quality	7.26	1.319	151
Operational Efficiency-Extent of non productive time reduced by operational quality	7.42	1.344	151
Operational Efficiency-Extent of efficient resource utilization due to operational quality	7.35	1.323	151
Operational Efficiency-Extent of cost of quality reduced by operational quality.	7.25	1.297	151

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Operational Efficiency-Extent of non value added cost reduced by operational quality	22.03	13.439	.831	.915
Operational Efficiency-Extent of non productive time reduced by operational quality	21.86	13.241	.836	.914
Operational Efficiency-Extent of efficient resource utilization due to operational quality	21.93	13.289	.848	.910
Operational Efficiency-Extent of cost of quality reduced by operational quality.	22.03	13.446	.850	.909